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STOMATOPODA

BY

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(Zoological Survey of India, Calcutta)

WITH THIRTEEN TEXT-FIGURES

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WITH THIRTEEN TEXT-FIGURES.

I AM grateful to Lt.-Col. R. B. Seymour Sewell, F.R.S., for the privilege of examining and reporting on the interesting collection of adult Stomatopods made, under his leadership, by the John Murray Expedition. The collection is small, comprising only sixteen species and varieties, but some of these have proved to be of great interest.

The genus *Squilla* is represented in the collection by nine species, one of which, from the African coast, is described as new. This species, *S. zanzibarica*, resembles the Mediterranean *S. mantis* in several important characters, but probably its nearest ally is the form, collected once only, and more than forty years ago, from Borneo. Another species of outstanding interest in the collection is *S. investigatoris* Lloyd. This species was originally collected in large numbers in 1906 by the R.I.M.S. " Investigator ", at one station in about 110 fathoms of water, on the South Arabian coast, close to the Gulf of Aden. The great interest of this species lies in the fact that the dactylus of the raptorial claw bears a very much larger number of teeth than in any other species of the genus, and, further, this number varies enormously in the species. The number of raptorial teeth is generally a very constant character in the Stomatopoda. In *S. investigatoris*, which seems to be a stable species in all other characters, there is, however, a wide range of variation in this respect. The John Murray Expedition collected a fair number of examples of this species, and these show a range of variation almost equal to that described by Lloyd. The original finding and the present records of the species suggest that *S. investigatoris* probably has a very limited range of distribution. A large number of fragments of this species were also collected at the depth of 1300 metres ; this is believed to constitute a depth record for any Stomatopod.

Only one specimen of the genus *Pseudosquilla* was collected by the Expedition. This is in the *monodactyla* stage, but as some of the adult characters, leading to a definite identification of the species, are present, this has been dealt with in the present report.

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The new species of *Lysiosquilla* described in this report shows some very peculiar features. It does not seem to have any near allies in the Indo-Pacific region, but shows a rather close resemblance to two species from the West Indies.

Gonodactylus is somewhat poorly represented in the collection, there being only two, or possibly three, forms, all belonging to the *chiragra* group of the genus. In connection with the identification of this material I have re-examined the extensive collections in the Indian Museum, and have briefly discussed the position and relationships of the different members of this group. One of the forms has been provisionally identified as *G. demani* var. *espinosus* Borradaile ; this had so far been recorded only once from the Fiji group of islands in the Southern Pacific. The specimens of this variety in the John Murray collection show some interesting variations. One small specimen, probably referable to *G. chiragra*, was found with the material collected at a depth of 1300 metres.

The sixteen species and varieties in the collection are listed below, together with the stations at which these were taken. For the sake of convenience, some details of the stations at which Stomatopods were collected, taken from the " List of Stations " in Sewell's introductory part in the present series of Reports, and the names of the species collected at each station are appended.

Kemp's masterly monograph (1913) on the Indo-Pacific Stomatopoda has been a source of invaluable help and inspiration to me throughout. His clear grasp and lucid treatment of the subject makes the task of dealing with any collection of Indo-Pacific Stomatopods comparatively easy. Bigelow's work (1931) on the Stomatopoda of the Southern and Eastern Pacific Oceans has also been of great help.

I have not considered it necessary to give detailed synonymies of the species. These have been given by Kemp and brought up to about 1930 by Bigelow for the species that he dealt with. Dollfus (1938) has given complete synonymies for the species included in his paper on the Red Sea Stomatopods.

The three authors mentioned in the previous paragraph and Komai (1927) have published very useful bibliographies. Balss* has recently published a very comprehensive and up-to-date list of references, which is as nearly complete as any list of this nature can be. In the list of literature at the end of the present report I have only included some of the important papers referred to in my account of the species.

The drawings illustrating this paper have been prepared under my supervision, by Babu Ram Bagchi with his usual care and accuracy, and for this my best thanks are due to him.

Dr. Waldo L. Schmitt, of the United States National Museum, has kindly examined, at my request, the type-specimen of *Squilla mantoidea* Bigelow, and has informed me that the mandibular palp is present in this species. I am grateful to Dr. Schmitt for help in this matter.

Finally, I would like to express my indebtedness to Dr. Baini Prashad, Director of the Zoological Survey of India, for the generous help and facilities he has always and ungrudgingly given me. The very rich collection of Stomatopods, containing a large number of types, in the Zoological Survey, under his charge, has been available to me for examination and comparison throughout the course of this work.

* Balss, H., Stomatopoda : in Dr. H. G. Bronn's 'Klassen und Ordnungen des Tierreichs', V, Abt. 1, Buch 6, Tiel II, pp. 149–173 (1938).

LIST OF SPECIES IN THE COLLECTION.

Genus **SQUILLA** Fabricius.

	Station from which collected.
Squilla fasciata de Haan	146
S. gilesi Kemp	70, 75
S. zanzibarica sp. nov.	106
S. gonypetes Kemp	72
S. indica Hansen	137, 147
S. investigatoris Lloyd	79, 190, 194
S. ? investigatoris Lloyd	33
S. raphidea Fabricius	72
S. annandalei Kemp	75

Genus **PSEUDOSQUILLA** Dana.

Pseudosquilla ciliata (Fabricius)	M.B. II(*a*)

Genus **LYSIOSQUILLA** Dana.

Lysiosquilla maculata (Fabricius)	Extra, Aden Harbour.
L. multifasciata Wood-Mason	72
L. sewelli sp. nov.	176, 194

Genus **GONODACTYLUS** Latreille.

Gonodactylus demani var. *spinosus* Bigelow	37, M.B. I(*b*), M.B. I(*d*)
G. demani var. *? espinosus* Borradaile	45, M.B. I(*b*)
G. chiragra (Fabricius) *s.l.*	33

List of Stations at which Stomatopods were Collected, with the Names of Species Obtained at each Station.

Red Sea.

Station M.B. I(*b*). 13° 39′ 30″ N., 42° 43′ 00″ E., bay between Gt. Hanish and Suyul Hanish Islands; 17.ix.33; 29 metres; bottom—sand, shells and coral; rectangular dredge, width 18 in.

Gonodactylus demani var. *spinosus* Bigelow.

G. demani var. *? espinosus* Borradaile.

Station M.B. I(*d*). 13° 39′ 30″ N., 42° 43′ 00″ E., bay between Gt. Hanish and Suyul Hanish Islands; 17.ix.33; 26 metres; bottom—sand, shells, and coral; rectangular dredge, width 18 in.

Gonodactylus demani var. *spinosus* Bigelow.

Aden Harbour.

Station Extra. Aden Harbour; 17.x.33; surface; hand net.

Lysiosquilla maculata (Fabricius).

Gulf of Aden.

Station 33. 13° 41′ 00″ N., 48° 17′ 00″ E. to 13° 40′ 00″ N., 48° 19′ 00″ E.; 15.x.33; 1295 metres; bottom—green mud; Agassiz trawl.

Fragments of *Squilla investigatoris* Lloyd.

Gonodactylus chiragra (Fabricius).

Station 37. 12° 47′ 30″ N., 45° 04′ 30″ E. to 12° 50′ 00″ N., 45° 05′ 00″ E.; 17.x.33; 18 metres; bottom—sand; otter trawl.

Gonodactylus demani var. *spinosus* Bigelow.

Station 176. 12° 04′ 06″ N., 50° 38′ 36″ E.; 2.v.34; 695 metres; bottom—green mud and sand; Agassiz trawl.

Lysiosquilla sewelli sp. nov.

Station 190. 13° 49′ 00″ N., 47° 49′ 12″ E.; 6.v.34; 183 metres; bottom—green sand and mud; grab of modified "Petersen" type.

Squilla investigatoris Lloyd.

Station 194. 13° 16′ 00″ N., 46° 20′ 24″ E. to 13° 16′ 36″ N., 46° 14′ 00″ E.; 7.v.34; 220 metres; bottom—?; Agassiz trawl.

Squilla investigatoris Lloyd.

Lysiosquilla sewelli sp. nov.

South Arabian Coast.

Station 45. 18° 03′ 30″ N., 57° 02′ 30″ E.; 29.x.33; 38 metres; bottom—lithothamnion; triangular dredge, each side 4 ft.

Gonodactylus demani var. ? *espinosus* Borradaile.

Station 79. 22° 12′ 48″ N., 59° 49′ 42″ E.; 30.xi.33; 102 metres; bottom—green mud; "Salpa" dredge, width 4 ft.

Squilla investigatoris Lloyd.

Station M.B. II(*a*). 17° 33′ 30″ N., 56° 01′ 30″ E., costal zone of N. of Jezirat Hallaniya, Khorya Morya Islands, Arabian Coast; 28.x.33; 11 metres; bottom—coarse sand; rectangular dredge, width 18 in.

Pseudosquilla ciliata (Fabricius).

Gulf of Oman.

Station 70. 25° 34′ 12″ N., 57° 23′ 30″ E. to 25° 33′ 00″ N., 57° 25′ 12″ E.; 25.xi.33; 196 metres; bottom—soft, green mud; otter trawl.

Squilla gilesi Kemp.

Station 72. 25° 38′ 18″ N., 56° 26′ 36″ E.; 26.xi.33; 73 metres; bottom—coarse sand and shells; Agassiz trawl.

Squilla gonypetes Kemp.

S. raphidea Fabricius.

Lysiosquilla multifasciata Wood-Mason.

Station 75. 25° 10′ 48″ N., 56° 47′ 30″ E. to 25° 09′ 48″ N., 56° 47′ 30″ E.; 28.xi.33; 201 metres; bottom—green mud; grab of modified "Petersen" type.

Squilla gilesi Kemp.

S. annandalei Kemp.

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ZANZIBAR AREA.

Station 106. 5° 38′ 54″ S., 39° 15′ 42″ E. to 5° 40′ 18″ S., 39° 17′ 36″ E.; 12.i.34; 212 metres; bottom—green mud; Agassiz trawl.
Squilla zanzibarbica sp. nov.

MALDIVE AREA.

Station 137. 0° 36′ 00″ S., 73° 12′ 48″ E., anchorage Addu Atoll; 23.iii.34; 46 metres; bottom—white mud; grab of modified "Petersen" type.
Squilla indica Hansen.

Station 146. 4° 50′ 18″ S., 72° 52′ 48″ E. to 4° 53′ 00″ S., 72° 55′ 24″ E.; 2.iv.34; 37 metres; bottom—soft, cream-coloured mud; otter trawl.
Squilla fasciata de Haan.

Station 147. 4° 53′ 12″ S., 72° 54′ 30″ E., anchorage Horsburgh Atoll; 2.iv.34; 27 metres; bottom—soft, cream-coloured mud; grab of modified "Petersen" type.
Squilla indica Hansen.

SYSTEMATIC ACCOUNT.

Genus **SQUILLA** Fabricius.

Squilla fasciata de Haan.

Squilla fasciata Kemp, 1913, pp. 34–36, pl. i, figs. 21–23; Hale, 1924, p. 496; Komai, 1927, pp. 309, 310; Tweedie, 1934, pp. 35, 36.

OCCURRENCE.—Station 146, Maldive Sea, 37 metres. 1 ♂, 74 mm.*

DESCRIPTIVE NOTES.—The single large male in the collection agrees closely with Kemp's detailed description, as also with named specimens from various localities in the collection of the Indian Museum. The distinctive colour pattern, mentioned by Kemp, is, however, lacking; only the terminal portions of the uropods are brown.

Most of the secondary sexual characters, mentioned by Komai, are seen in the present specimen, as also in the other large-sized examples that I have examined. The shape of the propodus of the raptorial claw is markedly different in the two sexes.

The post-anal carina on the ventral surface of the telson is fairly well developed in the Maldive example, but the two somewhat interrupted carinæ, sometimes present on either side of it, are lacking. The basal segment of the exopod of the uropod is, as is the case in all the specimens that I have seen, strongly ridged and grooved in a longitudinal direction on both the dorsal and the ventral surfaces.

Bouvier (1915, p. 308) has described a closely-related species from Mauritius under the name *S. fallax*, but, as was pointed out by Kemp and Chopra (1921, p. 300), this species differs from *S. fasciata* in a number of important characters, including the total suppression of the mandibular palp.

The two species, *S. ambigua* and *S. incerta*, described by Hansen (1926, pp. 6–10)

* Throughout the report the total length of the specimen, unless otherwise stated, represents the distance, in a median line, between the anterior end of the rostrum and the posterior extremity of the telson.

from the " Siboga " collection are also said to be somewhat close allies of *S. fasciata*, but, judging from Hansen's descriptions of the two species, the differences between these and de Haan's species (including the suppression of the mandibular palp in both of Hansen's species) are far too numerous, especially in the case of *S. incerta*, to require any critical comparison.

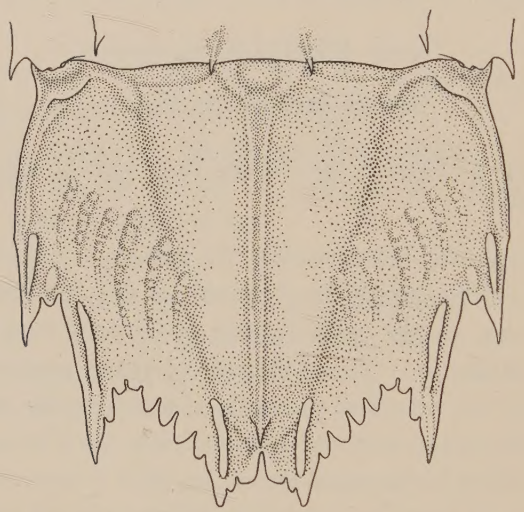
Distribution.—*S. fasciata* is mostly known from Japan, but has also been recorded outside this area from a few places. Komai has given a list of the Japanese localities from which the species has been recorded. It is also known from the Chinese Sea, South Australia, Singapore, Mergui, Tavoy and the Andaman Islands in the Bay of Bengal. The present record of the species from the Maldives extends its range considerably westwards.

S. fasciata is not so far known to live in deep waters ; there is no record of it from a depth greater than 50 fathoms.

Squilla gilesi Kemp.

Squilla gilesi Kemp, 1913, pp. 39, 40, pl. ii, figs. 25–27 ; Chopra, 1934, pp. 22, 23 ; Boone, 1938, pp. 203–208, pl. lxxi.

Occurrence.—Station 70, Gulf of Oman, 196 metres. 1 ♂, 1 ♀, 60 and 39 mm. Station 75, Gulf of Oman, 201 metres. 2 ♀♀, 78 and 66 mm.



Text-fig. 1.—*Squilla gilesi* Kemp. Telson of a large female, dorsal view. × 4½.

Descriptive Notes.—I have compared the John Murray Expedition specimens with the types in the collection of the Indian Museum and have found them to agree with the latter in every important character.

The secondary sexual characters of the male are generally well marked, but the swelling of the distal margin of the telson is sometimes not very distinct in medium-sized males. In the Indian Museum there are, among others, four male specimens collected by the R.I.M.S. " Investigator " from the north-east part of the Bay of Bengal. In one of these, 59 mm. long, the margins are very much swollen, as shown in Kemp's fig. 27 on pl. ii, while in another example, 53 mm. long, the swelling, though much less, can still be distinctly made out. In another male of the same size as the last mentioned example there is hardly any swelling at all. Similarly in the John Murray Expedition male, 60

mm. long, there is practcially no swelling along the margins. The median carina of the telson is swollen in all the males, much more so in large-sized examples than in small and medium-sized ones. I give here a figure of the dorsal surface of the telson of the large female (78 mm. long) from the present collection, and a comparison of it with Kemp's figure of the male telson clearly brings out the secondary characters of the telson in the two sexes. The raptorial claw is also appreciably different in the two sexes, the differences being discernible even in medium-sized specimens. These differences have been enumerated by Kemp and can be seen in the figure published by me in 1934.

The anterior border of the carapace on either side of the rostrum is distinctly slanting, considerably more so in young examples than in adults. The lobe on the inside of the longer limb of the bifurcate process of the uropod is greatly reduced in all the large specimens I have seen, but in smaller examples it is sometimes well developed and sometimes reduced.

Distribution.—*S. gilesi* is known both from the Bay of Bengal and the Arabian Sea. Boone has recently recorded it from Singapore also. In the Arabian Sea it has already been recorded from the Persian Gulf; the John Murray Expedition specimens are from the adjacent Gulf of Oman.

The species has not so far been collected in depths greater than 110 fathoms. Along the eastern coast of India it is littoral also, occurring quite close to the coast in depths of 20 fathoms and less.

Squilla zanzibarica, sp. nov.

Occurrence.—Station 106, Zanzibar area, 212 metres. 1 ♂, 59 mm. Type.

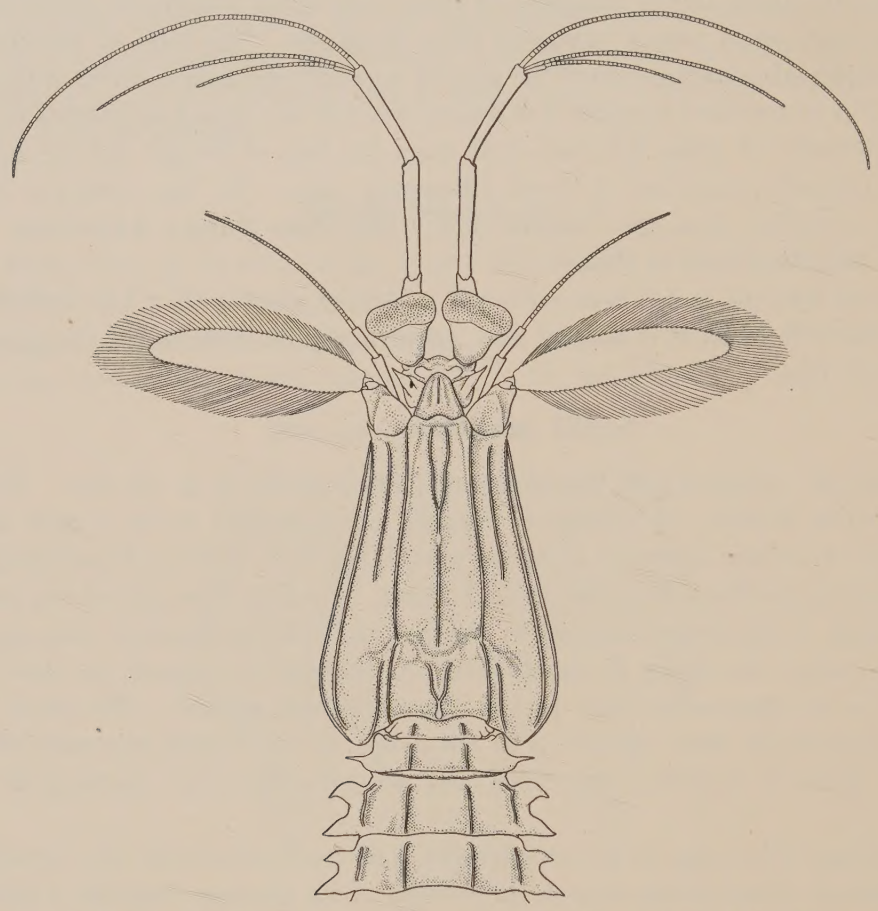
Descriptive Notes.—A species of *Squilla*, that appears to be a near ally of the Mediterranean *S. mantis* Latreille, is represented in the John Murray Expedition collection by a single female specimen from the African coast. Another close ally of the new species, and of *S. mantis*, is the form described by Bigelow in 1893 (see Bigelow, 1894, pp. 521–523) from Borneo under the name *S. mantoidea*. *S. zanzibarica* appears to show a greater resemblance to *S. mantoidea*, than to the Mediterranean species. The most important difference between the three species is in the shape of the lateral processes of the sixth and seventh thoracic somites—structures that are generally very constant in species of *Squilla*.

The carapace (Text-fig. 2) is considerably narrowed anteriorly, the breadth behind the antero-lateral spines being almost three-fifths of its greatest breadth, a little in front of the rounded postero-lateral angles. The surface is for the most part smooth, but the carinæ are very distinct. The median carina is well marked throughout, even anterior to the point of bifurcation, which starts about a third of the carapace length from the anterior end. A narrow triangular space, with somewhat sinuous sides, is enclosed by the bifurcation. The dorsal pit is clearly seen a little behind the point of bifurcation. The intermediate carina is interrupted for some distance in the posterior half of the carapace. The lateral carina is prominent throughout and ends at the anterior end in the sharp antero-lateral spine of the carapace. The lateral margins are somewhat thickened. The cervical and the gastric grooves are deeply impressed.

Unlike *S. mantoidea*, the rostrum is broader than long, has anteriorly convergent sides and is broadly rounded at the tip. The median carina is sharp and the margins are somewhat thickened.

The eyes are large and triangular, and the corneal axis is almost at right angles to

the peduncular axis, more or less as in Bigelow's species (see Bigelow, 1894, p. 522, text-fig. 14). The cornea is broader than any part of the stalk, and the corneal axis is only very slightly longer than the peduncular. The antennules and antennæ are as in *S. mantoidea*, but the antennary scale is proportionately longer. The ophthalmic somite is exposed in dorsal view, and its anterior margin is rounded. The lateral processes of the antennulary somite are somewhat large, horn-like structures, and each has a short, oblique, raised carina on the dorsal surface near the base. The processes of the ophthalmic somite are small and flat, and are rounded distally, as in *S. mantis*.



TEXT-FIG. 2.—*Squilla zanzibarica* sp. nov. Carapace and first three exposed thoracic somites. × 3.

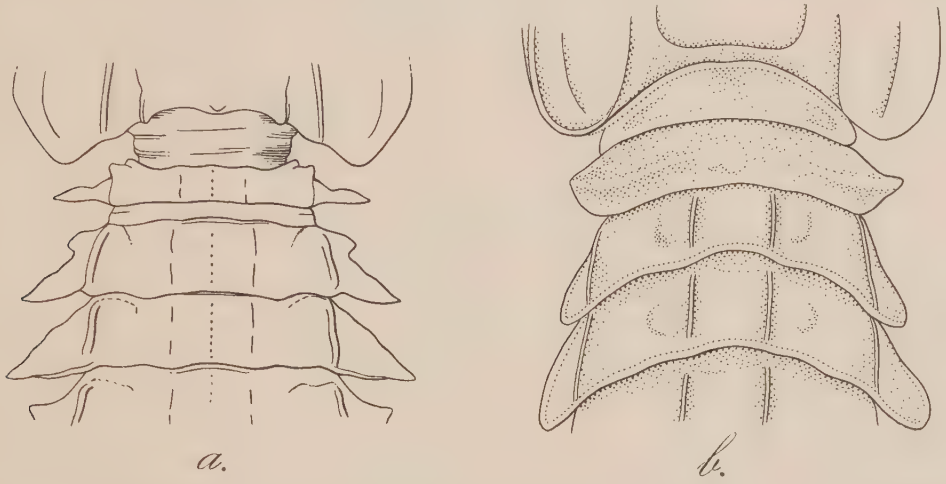
The mandibular palp is present and has the usual structure. There are epipodites on the first four legs. The inner ramus of the walking legs is linear.

The raptorial claw is as described by Bigelow for *S. mantoidea*. The dorsal carina of the carpus ends before reaching the distal end in a blunt lobe. In *S. mantis* this carina ends in two spines, and in Bigelow's species there is said to be one spine. The dactylus is evenly curved on the outside, and has a small, but fairly prominent, lobe near the base. It bears six teeth.

The lateral process of the fifth thoracic somite is, as in *S. mantoidea*, short, straight, obliquely flattened and acute at the tip. The ventral spine on this segment is triangular and sharp, and is directed somewhat forward. The lateral processes of the next two somites differ markedly from those of *S. mantoidea* (Text-fig. 3, *a*) or *S. mantis* (Text-fig. 3, *b*).

The sixth segment is bilobed on the margin, the posterior lobe being only a little longer than the anterior. Both the lobes are large ; the anterior is beak-like, while the posterior is triangular. There is a deep cleft between the two lobes, and both end in acute points. The margin of the seventh somite is very much like that of the sixth, but the anterior beak-like lobe is considerably smaller than the posterior. The eighth somite has a short, acutely-pointed anterior lobe, and a still smaller, blunt posterior lobe. For purposes of comparison I give here figures of the fifth, sixth and seventh thoracic somites of *S. mantis* and *S. mantoidea* after Giesbrecht (1910, pl. i, fig. 1) and Bigelow (1894, p. 521, text-fig. 13) respectively. The submedian carinæ are well marked on the thoracic somites.

The eight longitudinal carinæ are distinct on all the abdominal somites. The intermediate carinæ of somites 2–6 are broken up into two each, a short anterior and a very much longer posterior portion. The submedian and the intermediate carinæ of the sixth somite are swollen, and there is a blunt ridge running from near the base of the inter-



Text-fig. 3.—First three exposed thoracic somites of (*a*) *Squilla mantoidea* Bigelow (after Bigelow) ; (*b*) *Squilla mantis* Latreille (after Giesbrecht).

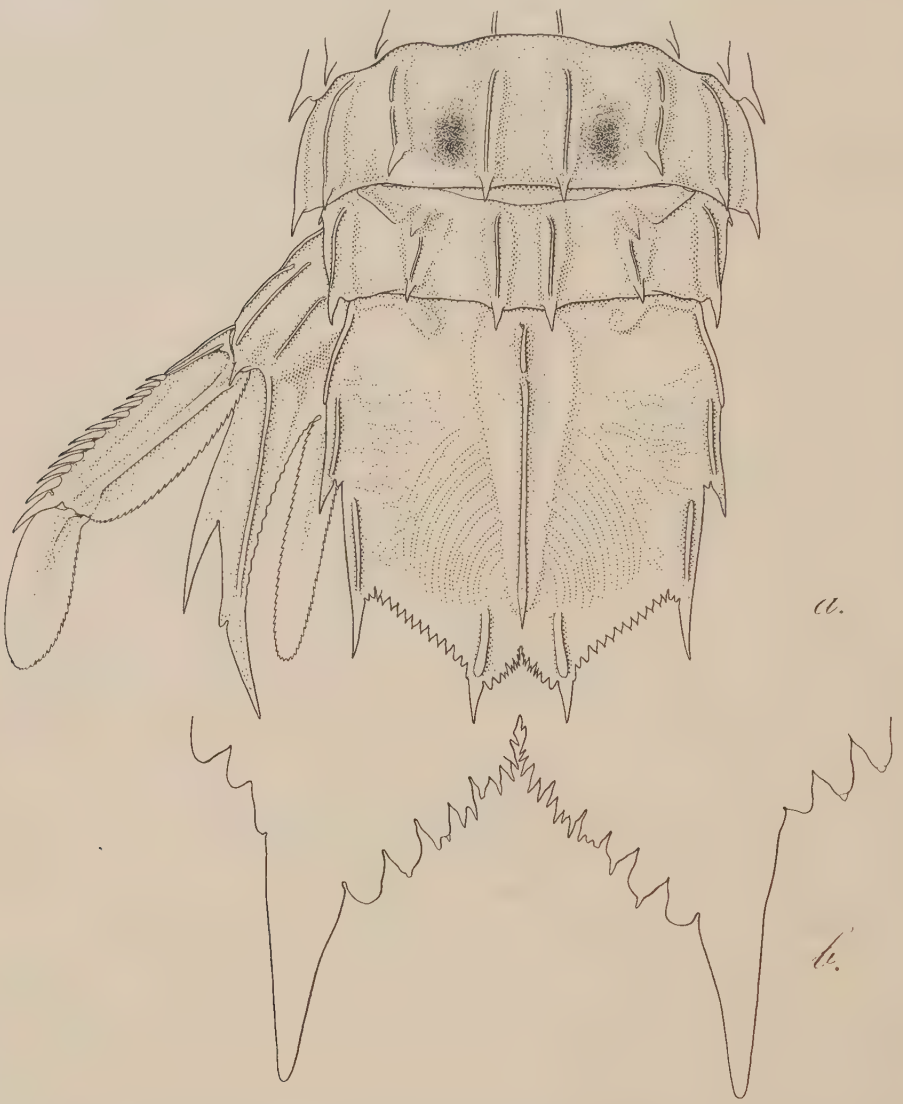
mediate carina outwardly in an oblique direction to the anterior margin of the segment, close to the base of the lateral carina. The following carinæ end in spines :

Carinæ.	Abdominal somites.
Submedian	5, 6
Intermediate	3, 4, 5, 6
Lateral	1, 2, 3, 4, 5, 6
Marginal	1, 2, 3, 4, 5

In *S. mantoidea* the submedian carinæ of the fifth somite do not end in spines.

The telson (Text-fig. 4, *a*) is a little broader than long, and agrees closely with Bigelow's description of *S. mantoidea*. The median keel is very prominent and ends in a large overhanging spine before quite reaching the posterior border. The rows of shallow pits and the keels on the inside of the rather long and slender marginal teeth are as described by Bigelow. The mid-ventral keel is rather short and fades away altogether even before reaching the middle of the telson. The number of marginal denticles is more than described for *S. mantoidea*. The submedian denticles are closely crowded together ; there are at least five or six main ones, but on account of minute secondary teeth on some of them

their exact number is difficult to make out. The somewhat complicated arrangement of these denticles is shown in Text-fig. 4, *b*. There are 14 or 15 intermediate denticles on either side; in *S. mantoidea* their number is said to be 11 or 12. The posterior margin of the telson on the inside of the denticles is not thickened, as is the case in *S. mantis*. The median notch is rather deep. The præ-lateral lobe is not very distinct.



Text-fig. 4.—*Squilla zanzibarica* sp. nov. (*a*) Last two abdominal somites, telson and uropods of one side. × 4½. (*b*) Part of posterior margin of telson to show the arrangement of submedian denticles. × 21.

Just in front of the base of the uropod the sixth abdominal segment bears a short spine at the anterior end of the margin in a slightly ventral position. The peduncular segment of the uropod has a dorsal spine overhanging the proximal segment of the exopod and two rather prominent longitudinal carinæ on its dorsal surface. The inner limb of the bifurcate process is very much longer than the outer and the lobe on its outer margin is much better developed than shown in Giesbrecht's figure of *S. mantis*. There are 13 movable spines on the outer margin of the proximal segment of the exopod on one side and 12 on the other; the most proximal spine is very minute and is possibly broken off

on one side. In *S. mantoidea* and *S. mantis* there are only eight such spines. The distal segment of the exopod, measured on its ventral aspect, is much shorter than the proximal, even more so than in *S. mantoidea*; in *S. mantis* these segments are subequal. The inner margin of the bifurcate process is serrate.

The measurements, in millimetres, of the single specimen that I have examined are given below:

Median length of body from tip of rostrum to posterior border of telson	59·0
,, ,, of carapace, excluding rostrum	13·5
Anterior breadth of carapace behind antero-lateral spines	6·2
Greatest breadth of carapace in front of postero-lateral angles	10·6
Median length of rostrum	1·9
Basal breadth of rostrum	2·3
Length of corneal axis of eye	3·1
,, of peduncular axis of eye	3·0
,, of antennary scale	10·0
Greatest breadth of abdomen	13·5
Median length of telson	9·6
Greatest breadth of telson	11·5
Median length (ventral) of proximal segment of exopod of uropod	7·5
,, ,, ,, of distal segment of exopod of uropod	5·0

The specimen has very little coloration left. There is, however, a faded patch of light brownish colour on the middle of the second abdominal somite, and two small, but more distinct, patches, one on either side of the submedian carina of the fifth abdominal segment, close to its posterior border. There may possibly have been a transverse band on the carapace in the region of the cervical groove and the telson also may have been lightly pigmented close to the margins. The inner uropod and the distal part of the bifurcate process also show traces of pigmentation.

The single female specimen on which *S. zanzibarica* is based was collected by the John Murray Expedition on January 12th, 1934, with Agassiz trawl at Station 106 (5° 38′ 54″ S., 39° 15′ 42″ E. to 5° 40′ 18″ S., 39° 17′ 36″ E.), a little to the north-west of Zanzibar at a depth of 212 metres. The sea bottom at this place consisted of green mud.

S. mantoidea Bigelow is also known from a single female example, 120 mm. long, from Borneo. The exact locality and the depth from which it was obtained are not recorded. *S. mantis*, on the other hand, is very commonly met with in the Mediterranean, and it has also been recorded along the coast of Portugal, in the English Channel and in the North Sea; Giesbrecht (1910, p. 33) regards its presence in the Atlantic Ocean as open to doubt, but it is occasionally taken on the S.W. coasts of England.

Some of the important differences between Bigelow's *S. mantoidea* and the new species may be briefly enumerated here.

(1) The rostrum is broader than long and its sides distinctly converge anteriorly.

(2) The carapace is somewhat longer as compared with its posterior breadth.

(3) The lateral processes of the sixth and seventh thoracic somites are prominently bilobed, the anterior lobe being beak-like and shorter than the posterior.

(4) The submedian carinæ of the fifth abdominal somite end in spines.

(5) The ventral keel on the telson is short.

(6) The number of intermediate denticles on the telson is larger.

(7) The terminal segment of the outer uropod is proportionately shorter.

(8) There are more movable spines on the outer margin of the proximal segment of the outer uropod.

S. mantoidea and *S. zanzibarica* differ from *S. mantis*, among other characters, in having transverse eyes, in the margin of the sixth thoracic somite being bilobed, in having the posterior margin of the telson not thickened and in the terminal segment of the outer uropod being distinctly shorter than the proximal.

The mandibular palp is present in all the three species. Dr. Waldo L. Schmitt, of the United States National Museum, has, at my request, very kindly examined the type-specimen of *S. mantoidea* Bigelow and has found the mandibular palp to be present and well developed.

Squilla gonypetes Kemp.

Squilla gonypetes Kemp, 1913, pp. 54, 55, pl. iv, figs. 42–44 ; Kemp and Chopra, 1921, pp. 300, 301 ; Gravier, 1938, pp. 166–168 ; Dollfus, 1938, p. 193.

Occurrence.—Station 72, Gulf of Oman, 73 metres. 2 ♂♂, 4 ♀♀, 35–56 mm.

Descriptive Notes.—Of the six specimens in the present collection, five are unfortunately without their raptorial claws, while the sixth, a female, has only one claw present. This last-mentioned specimen is 56 mm. long from the tip of the rostrum to the posterior border of the telson, and is thus only a little longer than the largest example recorded by Kemp, which, measured in a similar way, is only 53 mm. long.

The specimens agree on the whole very closely with the type-specimens and the other named material in the Indian Museum collection. The species resembles *S. quinquedentata* Brooks (*vide* Kemp, 1913, pp. 52, 53) rather closely, but can be distinguished from it by the characters enumerated by Kemp, and especially by the shape of the lateral processes of the sixth and seventh thoracic somites.

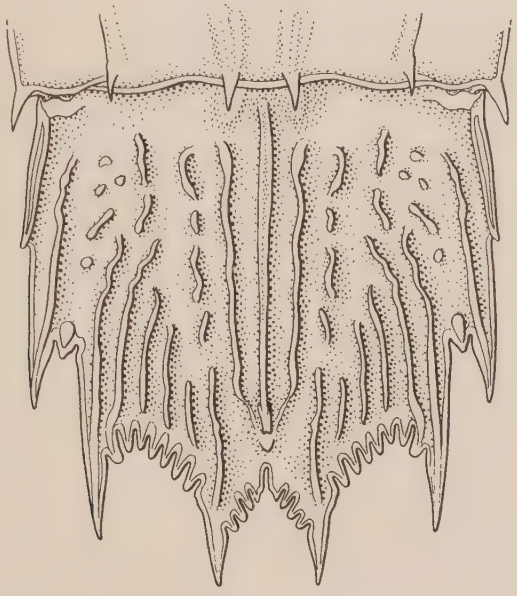
The largest female in the John Murray collection shows an interesting feature. On the dorsal surface of the telson (Text-fig. 5) there is the usual median carina and the oblique rows of pits. These pits have become confluent, forming rather deep grooves, as is sometimes the case in this species, and more often in *S. quinquedentata*, but the margins of these grooves have become distinctly thickened, forming a series of oblique, rounded carinæ, as shown in the accompanying text-fig. In addition to these oblique carinæ there are two (one complete and one considerably broken up) longitudinal carinæ on either side of the median carina. The general appearance of the telson in this specimen is somewhat like that of *S. fasciata* de Haan (see Kemp, 1913, p. 35, pl. i, fig. 23). Traces of these carinæ, especially the oblique ones, are, however, faintly visible in the larger of the two type-specimens of the present species also, but the longitudinal carinæ on either side of the median carina cannot be made out. In another male specimen in the present collection the rounded oblique carinæ are fairly distinct, but the longitudinal carinæ are hardly noticeable.

The spine formula is as given by Kemp, but there are sometimes slight variations. Thus, in one or two specimens the intermediate carina of the third abdominal somite does not terminate in a distinct spine, but in a somewhat acute point. Similarly, in two examples, a male and a female, the lateral carina of the first abdominal somite terminates

in a distinct spine, while in the remaining four specimens this carina ends in a spine only on the last five abdominal somites, as is generally the case in this species.

The colour of the species is as described by Kemp, and the two patches on the abdomen are clearly seen in all the specimens. In addition all my specimens have small pigment marks or patches on the inside of the lateral carina on the first five abdominal somites and similar marks on the outside of these carinæ on the sixth and seventh thoracic segments. These marks, though not mentioned by Kemp, are faintly visible in the types and several other specimens in the Museum collection also.

The female specimen from the Gulf of Suez, described by Gravier (1938) and also referred to by Dollfus (1938), does not quite agree with typical examples of *S. gonypetes* in the shape of the lateral processes of the sixth and seventh thoracic somites, and in a few other minor characters.



Text-fig. 5.—*Squilla gonypetes* Kemp. Dorsal surface of telson of a female 56 mm. long. × 6.

S. gonypetes resembles *S. quinquedentata* so closely that Sunier (1918, p. 66) has suggested that it is only a young form of the latter. Kemp and I (1921) were unable to agree with this view, chiefly on the ground that the eyes are more oblique in *S. gonypetes* than in Brooks' species, whereas if the former were only a young of the latter one should expect to find the cornea more transversely placed in it. The lateral processes of the sixth and seventh thoracic somites are also different in the two species ; the shape of these processes always remains more or less constant in a species irrespective of age. The dark patches on the second and fifth abdominal somites are very characteristic of the present species.

Distribution.—*S. gonypetes* has been recorded from the China Sea, the Java Sea, the Mergui Archipelago, the Andaman Islands, the Arakan and Vizagapatam coasts of Burma and India respectively, the Persian Gulf and the Gulf of Suez. The greatest depth at which the species has so far been taken does not exceed 60 fathoms. The present record from the Gulf of Oman at the mouth of the Persian Gulf at a depth of about 40 fathoms does not extend either the geographical or bathymetrical range of the species.

A small specimen about 20 mm. long, taken from Station 72 along with the six specimens described above, is also referred to *S. gonypetes*. The specimen is badly crushed and extensively damaged; the raptorial limbs are also missing. The few characters that can be made out suggest its being conspecific with the examples referred to above.

Squilla indica Hansen.

Squilla indica Hansen, 1926, pp. 12–14, pl. i, figs. 4*a*–4*c*; Chopra, 1934, pp. 35–38.

Occurrence.—Station 137, Maldive area, 46 metres. 1 ♀, 24·5 mm.

Station 147, Maldive area, 27 metres. 1 ♂, 28·5 mm.

Descriptive Notes.—The two specimens in the present collection that I have referred to Hansen's species, though considerably smaller than the one I described in 1934, agree with it, as also with Hansen's description of the species, in all material respects. There are 7 teeth, including the terminal one, on the raptorial dactylus in each of the 4 claws present; in one of the "Siboga" specimens there were 8 such teeth. The lateral processes of the fifth thoracic somite are very typical of the species, and these, as also the processes of the sixth and seventh somites, agree exactly with the description and figure given in 1934. The species is further characterized by having very few spines terminating the longitudinal carinæ of the abdominal somites. Hansen has made no mention of these spines, but in the example from the Nicobar Islands previously described by me the submedian, intermediate and lateral carinæ of the last two abdominal somites only were found to end in spines, while the marginal carina terminated in a spine on the fourth and fifth segments only. In the present specimens the condition is somewhat similar and the spine formula is as given below:

Carinæ.	Abdominal somites.	
	Male.	Female.
Submedian	5, 6	5, 6
Intermediate	4*, 5, 6	5, 6
Lateral	4†, 5, 6	5, 6
Marginal	4, 5	4, 5

The median length of the rostrum is only a little more than its basal breadth. The antennular peduncle is slightly longer than the median length of the carapace. The anterior margin of the ophthalmic somite is evenly rounded, with a slight emargination in the middle. The lateral processes of the antennulary somite are small, flattened, leaf-like structures, somewhat more truncate distally than shown in Hansen's figure. The mandibular palp is absent and epipodites are present on the first two legs only.

The telson is as already described. The marginal teeth are rather long, and the denticles, except for the rounded, lobe-like structures, one each on the inside of the submedian and the intermediate teeth, are all like minute spinules.

The lobe on the outer margin of the inner spine of the bifurcate process of the uropod is, as usual in the species, large and prominent, and the margin anterior to the lobe deeply concave.

* The intermediate carinæ of the fourth somite end in sharp angles, rather than spines.

† The lateral carina of the fourth somite ends in a sharp spine on one side only.

The specimens have no distinctive colour-pattern, though the outer half of the terminal segment of the exopod and the distal portion of the endopod of the uropod are tinged with brownish colour.

The measurements in millimetres of the two specimens in the John Murray collection are given below :

	Male.	Female.
Total length of body	28·5	24·5
Median length of carapace	6·7	6·0
Breadth of carapace behind antero-lateral angles	3·0	2·8
Length of rostrum	1·3	1·1
Basal breadth of rostrum	1·1	1·0
Breadth of cornea	1·8	1·6
,, of telson	5·2	4·6
Median length of telson	4·3	3·6

The corneal index in both the specimens is about 3·7.

The question of the affinities of *S. indica* was discussed in 1934. The species seems to belong to the *nepa* group of *Squilla*, but its position in the group is very uncertain. The total absence of the mandibular palp, the great reduction in the number of epipodites, the larger number of raptorial teeth, the peculiar shape of the lateral processes of the free thoracic somites, and the great reduction of the spines on the abdominal segments are some of the characters that appear to be peculiar to this species.

Distribution.—*S. indica* was so far known only from the Celebes Sea (Hansen) and the Nicobar Islands in the Bay of Bengal (Chopra) ; the present record from the Maldives in the Arabian Sea, therefore, considerably extends its range westwards. The species has not been recorded from any considerable depths ; the two " Siboga " specimens were collected in 22 and 31 metres respectively, while the Nicobar example was taken in 13 fathoms of water. The present specimens also are from comparatively shallow waters, one from 46 and the other from 27 metres. They were collected with a grab and the bottom at the place of capture consisted of white mud and soft cream-coloured mud respectively.

S. indica does not appear to grow to a large size ; the largest specimen so far recorded is only 41 mm. long.

Squilla investigatoris Lloyd.

Squilla investigatoris Lloyd, 1907, pp. 10–12 ; Lloyd, 1908, pp. 29–35, pls. ii, iii ; Kemp, 1913, pp. 80–82, pl. vi, figs. 67, 68.

Occurrence.—Station 190, Gulf of Aden, 183 metres. 7 ♂♂, 7 ♀♀, 73–83 mm.

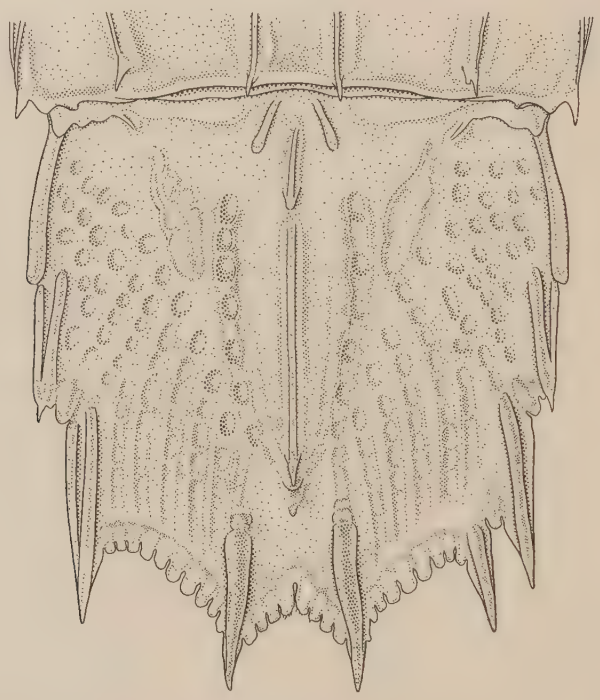
Station 194, Gulf of Aden, 220 metres. 3 ♂♂, 1 ♀, 77–105 mm.

Descriptive Notes.—The 18 specimens in the present collection agree very closely with the detailed descriptions given by Lloyd and Kemp, as also with the type-material preserved in the Indian Museum. The colour of the body, though showing slight variations in individual examples, is generally as described by Kemp.

There are, however, a few minor differences in the present specimens that may be mentioned. In several examples the rostrum is distinctly longer than its basal breadth, the somewhat upturned margins hardly converge at all anteriorly and the apex is more broadly rounded than is shown in Kemp's figure. The outer inferior margin of the merus

of the raptorial claw is more sharply angled than shown by Kemp, though in the type-material the condition is more or less as in the present examples.

The telson (Text-fig. 6) is very much like that of *S. massavensis* Kossmann (see Kemp, 1913, pp. 76–78, and Dollfus, 1938, pp. 188–190, text-figs. 2 and 3). The dorsal surface is profusely pitted, the pits being arranged in slanting rows. One row of pits, more prominent than the others, runs on each side of the median carina ; these two rows converge to a point beneath the apex of the spine that terminates this carina. The pits are closely arranged and sometimes form a sort of a channel, the two walls of which are thickened and in large specimens are broken up into low tubercles. The surface between the other rows of pits is also sometimes unevenly thickened in large examples. The tubercles on the side of the median carina are not, however, as prominent as in examples of *S. massavensis* of the same



TEXT-FIG. 6.—*Squilla investigatoris* Lloyd. Telson of a male specimen, about 82 mm. long, from the type-series, dorsal view. × 5.

size. The type-specimens also show these characters clearly, as can be seen in the accompanying text-figure. In larger individuals the condition is still more like that of *S. massavensis*, the walls of the channel on the side of the median carina being greatly thickened and broken up into distinct tubercles ; this condition is seen in the fragmentary specimen from Station 79 referred to on p. 157.

The ventral surface of the telson is more or less smooth. The anal opening is on a raised papilla and there is a short longitudinal carina running backwards from it for a short distance. In larger examples this carina is broken up into low tubercles. Near the outer anterior angle, on the ventral surface of the telson, there is on each side a short oblique carina running for a little distance obliquely inwards.

The number of movable spines on the outer margin of the basal segment of the exopod of the uropod is generally 8, as described by Lloyd and Kemp, but in two or three specimens 9 such spines have been found.

The short median longitudinal keel on the ventral surface of the eighth thoracic somite is very prominent in both the sexes.

The most important character of the present species is the large number of teeth that the raptorial dactylus carries on its inner margin ; another equally, if not more, remarkable feature is the great variation shown in the number of these teeth. In most species of the genus *Squilla* the number of raptorial teeth does not exceed 6, and the number found in any particular species is as a rule very constant. In *S. investigatoris* the number of these teeth varies between 10 and 18. Lloyd (1908) examined 461 specimens belonging to different species of *Squilla* from the Indian Museum collection, and found that 451 of these strictly conformed to the normal types of dentition of the different species to which they belonged and that variation from the normal type of dentition of the species occurred to the extent of about 2% of individuals only. His 17 specimens of *S. investigatoris*, on the other hand, showed 11 different types of dentition.

I have carefully counted the teeth in the 18 specimens in the present collection and have arranged them according to their different types of dentition, as was done by Lloyd for his material. These 18 specimens are listed below :

Locality.	Sex.	Approximate body-length in mm.	Number of raptorial teeth present.	
			Left claw.	Right claw.
Station 190	♀	77·0	12	12
	♀	78·0	14	14
	♀	78·0	16	15
	♀	79·5	×	16
	♀	80·5	14	14
	♀	81·0	13	13*
	♀	82·0	11	12
	♂	73·0	15	15
	♂	78·0	12	13
	♂	78·0	17	15
	♂	80·0	12	13
	♂	82·0	13	14
	♂	83·0	12	12
	♂	83·0	14	14
Station 194	♀	78·0	×	13
	♂	77·0	13	13
	♂	101·0	15	16
	♂	105·0	14	15

Note.—Most of the specimens show a tendency (sometimes even well marked) of having some of the teeth, especially the distal ones, arranged in pairs. This has already been remarked by Lloyd.

Thus, out of the 18 specimens in the present collection 16 have the raptorial dactyli of both the sides present, while in two examples the left dactylus is missing. These 34 dactyli examined show that the number of teeth varies between 11 and 17. In the material examined by Lloyd the range of variation was from 10 to 18, but only one claw had 10 teeth, one 18 and none 11 or 12. Arranging the 16 complete specimens on the basis

* The two terminal teeth of this claw are broken, but their stumps are present.

of their raptorial teeth, as Lloyd has done, the following 11 types, somewhat different from those of Lloyd, are obtained :

Type.	Teeth present in type.		Number of individuals of the type.
	Left claw.	Right claw.	
1	11	12	1
2	12	12	2
3	12	13	2
4	13	13	2
5	13	14	1
6	14	14	3
7	14	15	1
8	15	15	1
9	15	16	1
10	16	15	1
11	17	15	1
		Total	16

Taking Lloyd's 17 specimens with the 16 complete ones in the present collection the following 18 types of variation are obtained :

Type.	Teeth present in type.		Number of individuals of the type.
	Left claw.	Right claw.	
1	10	16	1
2	11	12	1
3	12	12	2
4	12	13	2
5	13	13	5
6	13	14	1
7	14	13	1
8	14	14	5
9	14	15	1
10	15	15	3
11	15	16	1
12	16	15	2
13	16	16	3
14	16	17	1
15	17	15	1
16	17	16	1
17	17	17	1
18	17	18	1
		Total	33

It is thus seen that in a small collection of 33 individuals there are as many as 18 different types of dentition on the raptorial claw, showing the enormous variability of the

species in respect of a character that is generally very stable in the Stomatopoda. One fact that may perhaps be significant comes out of the above table and that is that a comparatively large number of individuals possess the same number of teeth on the two claws, or that the types in which the number of teeth on the two claws is the same preponderates over the types in which the number is dissimilar. Thus there are five specimens having 13 teeth on each claw, five with 14 on each claw and three each with 15 and 16 teeth respectively. There are also two examples with 12 teeth on each dactylus. The number of specimens belonging to any of the other, or asymmetrical, types is in no case more than two. Taking all the specimens that have the same number of teeth on the two claws one finds that 18 out of 33 examples, or more than half the individuals, show this symmetry of dentition. The number of specimens examined is, however, too small for any conclusions to be drawn.

Apart from the frequency of the different types of dentition on the two claws it may be useful to consider the number of teeth that occur most commonly on the individual claws. For this purpose there are 34 dactyli in the present collection that have to be considered, and these can be grouped with regard to the number of teeth present on each dactylus as in the following table :

Number of teeth.	Number of dactyli in which present.
11	1
12	7
13	8
14	8
15	6
16	3
17	1
Total	34

Taking the 34 claws examined by Lloyd also into account, the 68 dactyli thus obtained may be grouped as follows :

Number of teeth.	Number of dactyli in which present.
10	1
11	1
12	7
13	15
14	13
15	11
16	13
17	6
18	1
Total	68

It is thus seen that whereas the number of teeth on the raptorial dactylus in *S. investigatoris* varies between 10 and 18, the number of claws having 10, 11 or 18 teeth is very

small indeed, all the three groups taken together constituting less than 5% of the claws examined. The largest number of claws are with 13–16 teeth, more than three-fourths of the specimens falling in this group. Claws with 12 or 17 teeth are also fairly common. Working out the proportions for these groups the following figures are obtained :

Dactyli with 13–16 teeth constitute 76·47%.
,, with 12 or 17 teeth constitute 19·12%.
,, with 10, 11 or 18 teeth constitute 4·41%.

If the two collections, Lloyd's collection and the John Murray collection, are taken separately the percentages are slightly different.

To sum up, in *S. investigatoris*—

(1) There is an enormous range of variation in the types of dentition on the two claws ;

(2) The number of teeth on the two claws may be similar or dissimilar ;

(3) The types having the same number of teeth on the two claws seem to preponderate over types having different number of teeth ; and

(4) The number of teeth on the raptorial dactylus met with in the species varies most commonly between 13 and 16, sometimes between 12 and 17, and rarely between 10 and 18.

Squilla investigatoris does not appear to grow to a large size. The largest specimen in Lloyd's collection was 84 mm. long, while the two largest examples in the present collection measure a little over 100 mm. from the tip of the rostrum to the posterior border of the telson. There is another fragmentary individual in the collection, referred to below, that must have been about 115 mm. long.

Distribution.—So far as is known at present *S. investigatoris* has a very limited range of distribution. The type-material was collected in the Gulf of Aden, and one specimen, mentioned by Kemp, was obtained in the Persian Gulf. The present specimens are also from the Gulf of Aden, very close to the locality from which the " Investigator " material was collected. One fragmentary specimen in the present collection is from the South Arabian coast. The species, as known at present, seems to extend from the Persian Gulf, along the South Arabian coast, to the Gulf of Aden. The John Murray Expedition did not collect this species either in the Red Sea or in any other part of the Arabian Sea that it explored.

Lloyd (1908) has referred to the large numbers in which the species was found in the only locality in which the " Investigator " discovered it. The present collection does not bear this out in any very striking manner, but it is still noteworthy that 14 specimens were collected in 0·5 sq. m. of the sea floor by the grab at Station 190, and a still larger number, represented by their telsons and other fragments (*vide* p. 157, *infra*), were trawled at Station 33. The remaining species of Stomatopoda in the John Murray collection are represented in most cases by a much smaller number of specimens from any one station.

S. investigatoris is so far recorded from comparatively deep waters only. The type-material was obtained in 110 fathoms of water, while the present specimens were collected in 183 and 220 metres. The fragmentary specimen from the South Arabian coast was obtained in 102 metres, while the other fragments from Station 33 (*vide* p. 157, *infra*) came from the enormous depth of about 1300 metres. The depth at which the single specimen from the Persian Gulf, referred to above, was collected is not recorded.

There is a fragmentary specimen in the John Murray collection that is also referred to *S. investigatoris*. The anterior part of the animal is altogether missing, only the abdomen and the telson with their appendages being present. In *S. investigatoris* the raptorial claw is the most characteristic feature of the species, but a very careful examination of the parts present with similar parts of specimens in the type-series shows that the fragmentary individual is referable to Lloyd's species. The colour is considerably faded, but the general plan is almost similar to that in other specimens.

The telson is profusely pitted and the walls of the channel, formed by the row of pits on either side of the median carina, becoming confluent, are broken up into distinct tubercles (see p. 152, *supra*).

Occurrence.—Station 79, South Arabian coast, 102 metres. 1 fragmentary specimen.

Judging by the size of the parts present the specimen must have been between 110 and 115 mm. long.

Squilla ? investigatoris Lloyd.

Squilla investigatoris Kemp, 1913, pp. 80–82, pl. vi, figs. 67, 68.

Occurrence.—Station 33, Gulf of Aden, 1295 metres. Fragments of a large number of specimens.

Descriptive Notes.—A large number of fragments of a *Squilla*, that I have referred to *S. investigatoris*, consisting mostly of telsons (some with the sixth abdominal somite attached), uropods and a few bits of carapace are in the collection. There are also two or three antennules and antennæ, with their scales, and a few other unrecognizable odd bits. There are no raptorial claws or other parts of the body that could help in making a definite identification. Practically no soft parts of the animals are present, and only fragments of the outer chitinous covering have been preserved. As this collection is from a great depth—probably the greatest depth from which a Stomatopod has so far been recorded—I have made special efforts to identify these fragments, as far as possible.

The few bits of carapace that have been preserved show the cervical groove deeply impressed and the carinæ distinct. The rostrum is subquadrate, with a broadly rounded apex and the sides hardly converging anteriorly. The anterior breadth of the carapace is almost half of its median length, rostrum included, as is seen from the following measurements, taken from comparatively large fragments of the carapace :

Median length of carapace, including rostrum	19 mm.
Anterior breadth of carapace	10 ,,

In the allied species *S. massavensis* Kossmann (*vide* Kemp, 1913, pp. 77, 78) the sides of the rostrum markedly converge anteriorly and the apex is less broadly rounded. The carapace is also slightly narrower at the anterior end than in *S. investigatoris*.

The sixth abdominal segment and the telson in *S. investigatoris* resemble very closely those of *S. massavensis* and some other species. In fact the resemblance is so close that on an examination of the telson alone it is sometimes difficult to distinguish examples of the present species from comparatively young specimens of *S. massavensis*. In medium-sized and large examples of the latter-named species the rows of tubercles on either side of the median carina of the telson are a very important distinguishing character, but, as already pointed out, in large-sized specimens of *S. investigatoris* also there is a tendency

towards the formation of similar tubercles. Coupled with these tubercles there are, however, two or three other characters of rather minor importance that may be of some help in recognizing the telsons of the two species. The carinæ on the marginal teeth of the telson are considerably more swollen in *S. massavensis*, especially in medium-sized and large examples, than in *S. investigatoris*, and the number of denticles, both submedian and intermediate, is generally smaller than in Lloyd's species. There are 33 telsons in the present collection and of these 29 are complete. I have examined the denticles in all these, and have found that the number of submedian denticles is in most cases 4 or 5, though really it varies between 3 and as many as 8. In the same way there are generally 9 or 10 intermediate denticles, the number varying between 8 and 11. In *S. massavensis* there are usually 3 submedian and 7–9 intermediate denticles. Further, in Kossmann's species the serration on the inner side of the longer limb of the bifurcate process of the uropod appears to be finer and more evenly arranged and extends further distally than in *S. investigatoris*. The lobe on the bifurcate process is also slightly smaller in *S. massavensis* than in the other species.

Judging by the characters enumerated above, the fragments under reference have been identified as those of *S. investigatoris*. This species and *S. massavensis* are both known to live in the Arabian Sea, but the locality from which these fragments were obtained is very close to the places from which *S. investigatoris* has been collected.

The enormous depth of 1300 metres from which these fragments were collected is very remarkable and probably constitutes a record for any Stomatopod. In view of the fact that no complete specimens were obtained, it is possible that the species does not actually live at this great depth and that dead specimens from higher levels had drifted here and their remains, mixed with mud, were dredged from this place. There are, however, a few small bits of muscles, etc., attached to the antennæ and mouth parts, etc., which might possibly indicate that the species does penetrate to this depth.

The fragments were obtained with the Agassiz trawl and the sea-bottom at this place consisted of green mud.

Squilla raphidea Fabricius.

Squilla raphidea Kemp, 1913, pp. 88–92, pl. vii, fig. 77.

Occurrence.—Station 72, Gulf of Oman, 73 metres. 1 ♂, 80 mm.

Descriptive Notes.—In the John Murray collection there is only one, rather immature specimen of this common Indo-Pacific species. As mentioned by Kemp, the rostrum in this species is rather variable. In my specimen it is unusually long, its narrowly-rounded apex going even slightly beyond the distal margin of the antennular somite ; the sides are markedly sinuous. The colour markings, mentioned by Kemp, are clearly seen; there is, in addition, a large oval patch on either side of the median carina of the carapace in front of the cervical groove. The posterior margin of the first abdominal somite is also defined by a line of dark pigment.

Distribution.—*Squilla raphidea* is a very common species all over the Indo-Pacific region and is frequently met with from Japan to the African coast. The species is not known to live in deep waters, most of the records being from depths up to 25 or 30 fathoms. Kemp (1918, p. 297) has recorded it from the brackish waters of Talé Sap in Siam also.

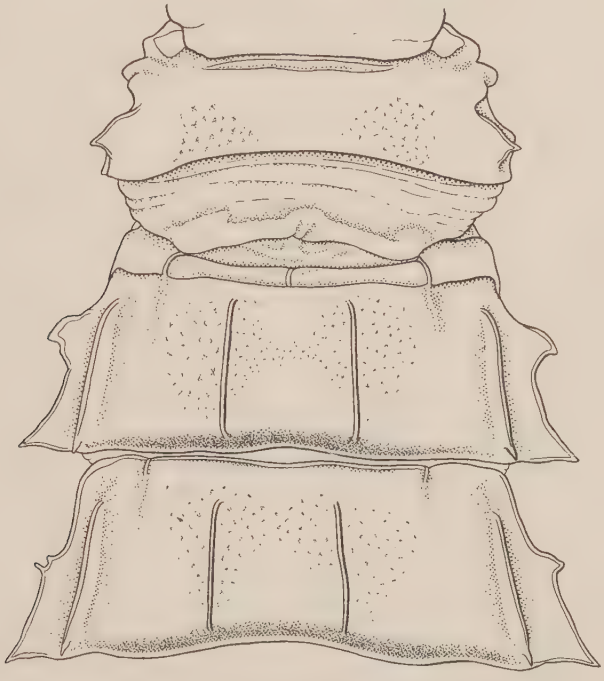
The species grows to a large size ; Kemp recorded an example from Bombay measuring 335 mm. in length.

Squilla annandalei Kemp.

Squilla annandalei Kemp, 1913, pp. 92, 93, pl. vii, figs. 78–80 ; Chopra, 1934, pp. 27, 28.

Occurrence.—Station 75, Gulf of Oman, 201 metres. 1 ♂, 123 mm.

Descriptive Notes.—A large male specimen of this somewhat uncommon species is in the collection. It agrees closely with the type-specimen in the collection of the Indian Museum in every important respect. The pigmentation of the terminal segment



Text-fig. 7.—*Squilla annandalei* Kemp. Dorsal view of fifth, sixth and seventh thoracic somites. × 4½.

of the outer uropod, the two dark spots on the telson and the transverse patch on the second abdominal somite are characteristic of this species and are clearly seen in the present example.

The tendency towards a secondary division into two lobes of the anterior lateral process of the sixth thoracic somite, remarked in 1934, is seen to a certain extent in the present example also. The anterior processes of this somite are rather broad, and somewhat more pointed than shown in Kemp's fig. 80. On the process of the left side there is a minute secondary lobe on the posterior margin ; the process of the right side is quite normal. The margin of the seventh somite on the left side also differs somewhat from Kemp's figure in having the anterior process somewhat smaller and being made up of two small lobes. On the right side the margin is normal. The exact shape of the processes on the two sides is shown in Text-fig. 7.

Distribution.—*Squilla annandalei* was so far known from the Java Sea, the Mergui Archipelago, the Gulf of Martaban and the mouth of the Hughli River ; the present record

from the Gulf of Oman in the Arabian Sea extends the range of the species very considerably westwards. All the previous records are from depths between 30 and 67 fathoms. The John Murray Expedition specimen extends the bathymetric range also to a little below the 100 fathom line.

The specimen was collected in the grab of a modified " Petersen " type and the bottom at the place of capture consisted of green mud.

Genus **PSEUDOSQUILLA** Dana.

Pseudosquilla ciliata (Fabricius).

Pseudosquilla ciliata Kemp, 1913, pp. 96–100 and 108; Bigelow, 1931, pp. 152–159; Dollfus, 1938, pp. 198–200.

Occurrence.—Station M.B. II(*a*), South Arabian coast, 11 metres. 1 ♀, 17 mm.

Descriptive Notes.—A small specimen, measuring about 17 mm. from the tip of the rostrum to the posterior extremity of the telson, belongs to what is known as the *monodactyla* stage of *Pseudosquilla*. The most striking features of this stage are the absence of distinct teeth on the raptorial dactylus, the absence of carinæ on either side of the median crest of the telson and the broadly-angled posterior margin of the telson, bearing a large number of minute denticles between the movable submedian spines.

The *monodactyla* stage of *P. ciliata* has been described in detail by Bigelow (1931). The present specimen, which is in a good state of preservation, agrees closely with Bigelow's description of the Hawaiian material. The dactylus of the raptorial limb has no teeth on its inner margin, but an examination through transmitted light reveals the rudiments of three teeth (including the apical one) under the integument. The propodus has 3 movable spines near the base, a series of 5 hairs instead of the usual pectinations and a distinct spine at the distal end, close to the articulation with the dactylus. The eyes are large and somewhat compressed laterally. The postero-lateral angles of the fifth abdominal somite are strongly spinous, but those of the fourth are only acute. The sixth abdominal somite has no intermediate spines, but the submedians and those at the postero-lateral angles are well developed. On the telson the median crest is rather low and poorly developed, and, as pointed out by Bigelow, ends in a sharp spine at a considerable distance from the margin. There are no crests on either side of the median crest. The posterior margin of the telson is broadly angled, as shown in Bigelow's figure (p. 157, text-fig. 5) and there are about 35 minute denticles, arranged like the teeth of a fine comb, between the articulated submedian spines. The 2 spines of the bifurcate process of the uropod are subequal and the inner margin of the outer spine is not markedly sinuous. The proximal segment of the exopod bears 8 movable spines on the outer margin; Bigelow has described 9 such spines in his Hawaiian specimens, though two of his examples from Porto Rico (1901, p. 156) had 8 spines. The paddle-like distal segment of the exopod and the 2 spines of the bifurcate process extend beyond the distal segment of the exopod. There are no colour-markings in my specimen.

The *monodactyla* stage of *Pseudosquilla ornata* Miers and *P. oculata* (Brullé), species closely related to *P. ciliata*, have been described by several workers, including Bigelow

(1931, pp. 162–164 and 166, 167). A comparison with Bigelow's descriptions shows that the John Murray Expedition specimen is referable to *P. ciliata*.

The adults of the present species have been described in detail by Kemp, Bigelow and several others. Kemp and Dollfus have given detailed synonymies of the species and the latter has added a list of records of its occurrence in the Red Sea.

Distribution.—*P. ciliata* has an extremely wide range of distribution, being one of the very few Stomatopods that live both in the Atlantic and the Indo-Pacific region. Kemp has given a long list of localities in both these areas where the species has been found.

The species lives in shallow waters only and is very abundant in coral reefs, oyster beds and other similar places. The present specimen was dredged at a depth of 11 metres, and the bottom at the place of capture consisted of coarse sand.

Bigelow believes that in the *monodactyla* stage *P. ciliata* and some other species inhabit the bottom during the day and swim near the surface at night.

Genus **LYSIOSQUILLA** Dana.

Lysiosquilla maculata (Fabricius).

Lysiosquilla maculata Kemp, 1913, pp. 111–116, pl. viii, figs. 86–91 ; Bigelow, 1931, pp. 169–173 ; Chopra, 1934, pp. 28–30.

Occurrence.—Extra Station, Aden Harbour, surface. 1 ♀, 156 mm.

Descriptive Notes.—The coloration of the John Murray Expedition specimen is very much like that shown in Kemp's fig. 88. There is one important character in which the present example differs from Kemp's detailed description, as also from all the other specimens of the species that I have seen. In *L. maculata* the dactylus of the raptorial claw bears on its inner margin 9–11 teeth, including the terminal one, the usual number being 10 and somewhat rarely 9. In the present specimen both the dactyli have 12 teeth each. The first or the proximal tooth is minute, but can be clearly seen even without a lens. So far as I am aware, 12 teeth on the raptorial dactylus have not been hitherto recorded in this species. All the teeth are slender and, as usual, are minutely serrated on both the margins. The terminal tooth is twice the length of the one preceding it. The dactylus is straight on the outer border, the breadth of the propodus is a little less than one-fourth of its length and there are 4 movable spines at its base ; the claw is of the male type, as described by Kemp.

As remarked by Kemp and Bigelow the eyes are proportionately small in large females. The present specimen also shows the same feature.

Total length	156 mm.
Median length of carapace	27·5 mm.
Breadth of cornea	6·3 ,,
Corneal index	4·3

Distribution.—*Lysiosquilla masulata* has a very wide range of distribution over the Indian Ocean and the Indo-Pacific region. It extends from Japan and Oceania on the east to as far west as the African coast. Kemp and Bigelow have recorded a large number of localities from which the species has been obtained. As mentioned by these authors,

the species has been met with in the Atlantic also, but seems to be very scarce there. Further, as pointed out by Bigelow, the specimens recorded from the Atlantic are not quite typical.

The species occurs in shallow waters only. Bigelow states that it is so abundant in Honolulu that it forms the object of a fishery.

L. maculata grows to a large size ; a male specimen 315 mm. long has been recorded.

Lysiosquilla multifasciata Wood-Mason.

Lysiosquilla multifasciata Wood-Mason, 1895, pp. 1, 2, pl. i, figs. 4–7 ; Kemp, 1913, pp. 122–124 ; Kemp, 1915, pp. 175, 176, pl. i, figs. 2, 3 ; Schmitt, 1922, pp. 144–146, pl. xix, figs. 15–18 ; Dollfus, 1938, pp. 203, 204.

Occurrence.—Station 72, Gulf of Oman, 73 metres. 5 ♂♂, 4 ♀♀, 41–64 mm.

Descriptive Notes.—The John Murray Expedition collected a fine series of nine specimens of the present species. There are, however, only three specimens in which the raptorial claws are present ; of these, two males (45 and 64 mm. long) have only one claw each, while a large female, measuring 56 mm. in body length, has both the claws present. Two of the specimens are damaged, a large female (about 58 mm.) having the body badly crushed about the middle of the abdomen, and a male (53 mm.) with the telson and one or two posterior abdominal somites injured.

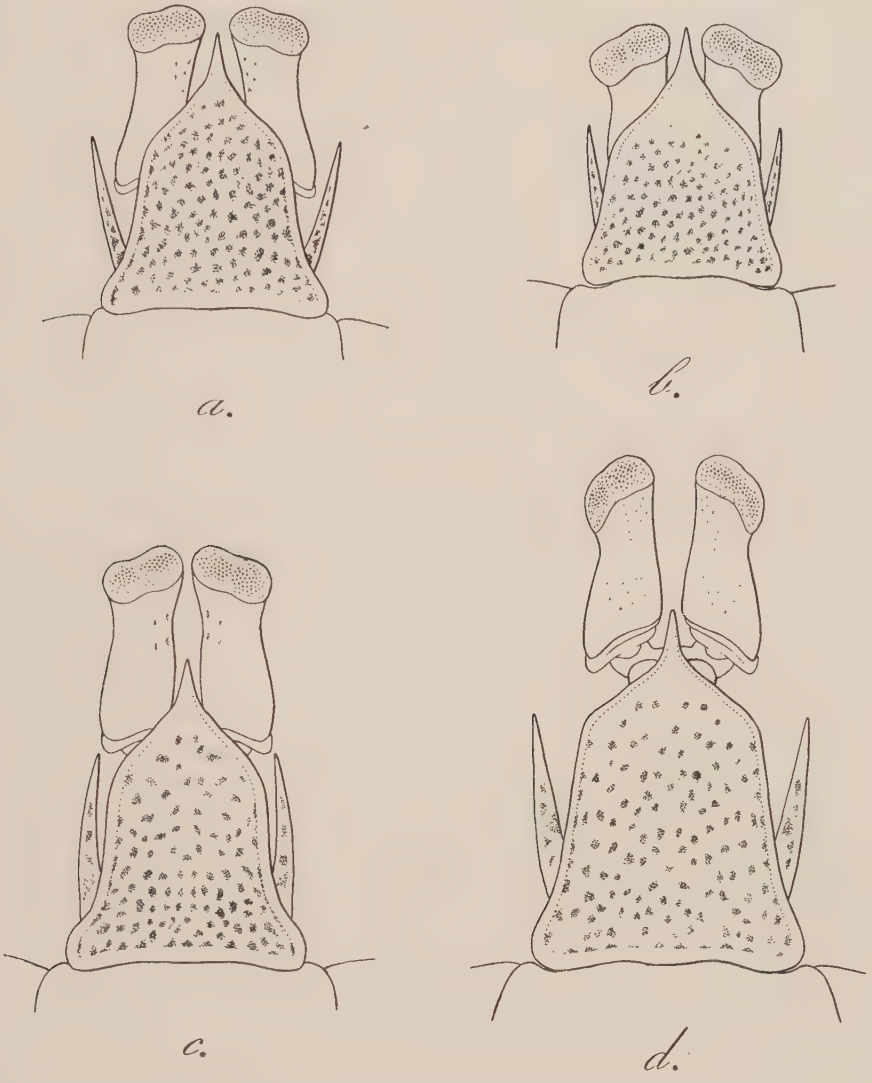
The colour pattern on the dorsal surface of the body agrees on the whole with that of the type, and some of the variations mentioned by Kemp (1915) are also seen in several examples. The two anterior bands of the carapace are faintly visible in two or three specimens only, but the posterior band is distinctly marked in all the examples. In most cases the anterior two-thirds of the carapace is covered by a large patch of pigment, and even where the anterior bands can be distinguished separately, they do not extend to the margins of the carapace. In most of the specimens the narrow anterior abdominal bands can be made out more or less clearly, and, as described by Kemp, are connected to the broad posterior bands mid-dorsally by a diffusion of pigment. In all the present examples the pigmentation is very much fainter than in the type-specimen, even though the latter has been preserved in spirit for a long time.

In structural characters also the Arabian Sea specimens resemble the type closely. The species is very easily recognized, among other characters, by the presence of two greatly unequal lobes near the base on the external margin of the raptorial dactylus.

The present specimens show interesting variations in two or three characters. The cornea of the eye is somewhat smaller than in the type-specimen, or in the two examples from the Philippines (Kemp, 1915) in the collection of the Indian Museum, and, whereas it is cylindrical in the three latter specimens, in the Arabian Sea material it is distinctly flattened and shows a tendency of being bilobed. This flattening and a tendency towards bilobing is slightly visible in the larger of the two Philippine examples also, but it is more marked in the present specimens.

In the three Indian Museum specimens that I have examined the rostrum covers the basal third of the eye-stalk, and the spine-like rostral tip extends to about the base of the cornea. In the specimens from the Gulf of Oman the condition varies a great deal. In a male specimen (45 mm.) the condition, as seen in Text-fig. 8, *a*, is more or less typical, as described by Wood-Mason ; in another male (53 mm.), though the tip reaches up to the

base of the cornea, the rostrum covers considerably more than a third of the eye-stalk. In four examples (one male 53 mm., and three females 41, 45 and 58 mm.) the rostrum covers the greater part of the eye-stalk and the rostral tip goes up to the end of the cornea, or even a little beyond it (Text-fig. 8, *b*). In the remaining three specimens the condition is still more interesting. In one large male (59 mm.) the rostrum covers only a very small



TEXT-FIG. 8.—*Lysiosquilla multifasciata* Wood-Mason. Dorsal view of rostrum, eyes and dorsal processes of antennular somite of: (*a*) a male, 45 mm.; (*b*) a female, 45 mm; (*c*) a male, 59 mm.; (*d*) a male, 64 mm. All × 10.

basal portion of the eye-stalk and the tip hardly extends to the middle of the stalk (Text-fig. 8, *c*); in the remaining two examples, a female (56 mm.) and a male (64 mm.) the rostrum does not even reach the base of the eye-stalk, the whole of which is left uncovered, and the tip barely extends a little beyond the base (Text-fig. 8, *d*). The eye-stalks are fairly well extended in all the specimens. The rostrum is typical except that the angles between the basal and the apical portions are more obtuse than shown in Wood-Mason's figure of the type. The spine of the rostrum is considerably shorter than the basal portion or the dorsal processes of the antennular somite. This is the condition in the type also,

but in the example described by Schmitt the rostral spine appears to have been much longer.

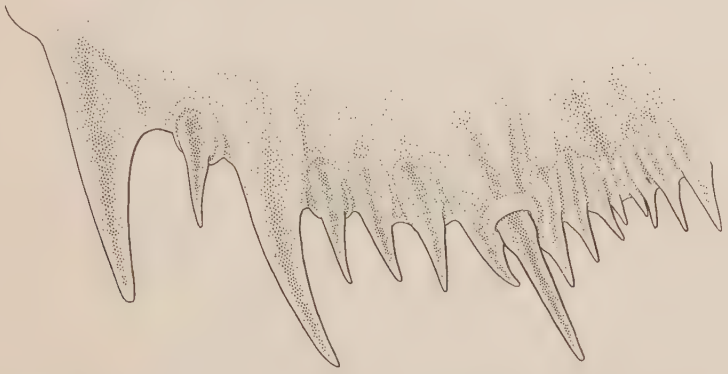
The raptorial dactylus has, on its outer margin, the two lobes characteristic of the species, the distal lobe being very much larger than the proximal. As already stated, there are only four raptorial claws present in my collection, and in all the four of them the dactylus is furnished with 6 teeth on the inner margin. The first, or the proximal, tooth is small in all the cases, and in the small male (45 mm.) it is minute. In the Philippine material examined by Kemp the larger examples had only 5 teeth on each dactylus, the younger 6; the first tooth was small in every case and placed very close to the next. In my specimens, as in the type, the first small tooth is not particularly close to the second. The antepenultimate tooth is always longer than the penultimate. The carpus has a large overhanging spine on its dorsal aspect.

Schmitt has laid considerable emphasis on the number and sizes of the various denticles between the spines or teeth on the posterior margin of the telson. Between the movable submedian teeth there are, in the type-specimen, 4 pairs of short denticles; these are evenly placed and somewhat increase in size from the innermost to the outermost pair. In the Philippine examples Kemp found 3 or 4 pairs; in the large Philippine specimen* in the Indian Museum there are 3 pairs, while in the smaller one there are 4. In his Chinese specimen Schmitt found only 3 paris of denticles, distinctly increasing in size from the innermost to the outermost pair. In the John Murray Expedition material there are 4 pairs, the innermost of which are minute, and the other pairs progressively increase in size towards the outermost. Seen from the ventral side the posterior margin of the telson is slanting upwards from the median line to the submedian spine of either side, and as the submedian denticles are placed on this sloping surface, they do not all arise at the same horizontal level, those of the innermost pair being distinctly more dorsally placed than the denticles of the next pair, and thus being partly hidden by them in ventral view. By examining the specimen in a slightly oblique view, either from above or from below, all the 4 pairs of denticles can be easily made out. In two examples one of the minute denticles of the innermost pair is broken on one side, leaving a microscopic stump, but on the other side the full complement of 4 denticles is present. There are invariably 4 denticles between the submedian and the intermediate spine of either side. According to Schmitt, the first and the third denticles, counting from the inner side, are the smallest, the second is the largest, while the fourth is intermediate in size between the second and the first or third. The large Philippine example that I have seen conforms to this description; the type-specimen also more or less agrees with it. In the John Murray Expedition specimens the size-variation of the intermediate denticles is not very clearly seen, but generally the second denticle, again counting from the inner side, is slightly larger than the others. In some cases the first and the second denticles are subequal and larger than the third and fourth. The exact arrangement and sizes of the various denticles in a large specimen from the Gulf of Oman are shown in Text-fig. 9. In the

* Only two pairs of submedian denticles are seen in Kemp's figure (1915, pl. i, fig. 3) of a large Philippine specimen, for the reason that the overhanging median tooth on the dorsal surface of the telson conceals, in a dorsal view, the two innermost denticles. In our large Philippine specimen also only two pairs of submedian denticles can be seen from above, but seen from the ventral surface, or in a slightly tilted position from above, all the three pairs can be easily made out. Schmitt mistook the submedian spines for the outermost denticles.

figure given by Dollfus also the sizes of the different denticles are not quite as described by Schmitt. As usual there is only one lateral denticle ; the larger Philippine example in the Indian Museum collection differs from all the other specimens that I have seen in having a small additional lateral denticle on the left side of the telson. On the right side there is only one denticle.

Distribution.—*Lysiosquilla multifasciata* was described by Wood-Mason from a single female specimen from Bombay. The species has a wide range of distribution over the Indo-Pacific region, extending from Japan to the Red Sea. It has been recorded from Japan (Komai, 1927), Formosa (Balss, 1910), Amoy on the Chinese coast (Schmitt, 1929), Philippine Islands (Kemp, 1915), Borneo (Nobili, 1903), and the Red Sea (Nobili, 1906; Tattersall, 1921 ; and Dollfus, 1938). Kemp has doubted the correctness of Nobili's records from the last two localities, chiefly for the reason that Nobili has not mentioned the two greatly unequal lobes on the outer margin of the raptorial dactylus, which is undoubtedly the most important structural character of the species. His description of



Text-fig. 9.—*Lysiosquilla multifasciata* Wood-Mason. Margin of the telson, showing the marginal spines and denticles of one side, seen a little obliquely from below. × 15.

the Red Sea specimens at least seems to indicate that he was dealing with the present species. It is noteworthy that in the length of the rostral spine and the position of the two innermost denticles between the submedian spines of the telson Nobili's Red Sea examples showed the same variation as has been noticed in the Gulf of Oman specimens. Also later records show that the species undoubtedly lives in the Red Sea. The presence of only 4 submedian denticles (instead of 6 or 8) in one of Nobili's specimens is unaccountable.

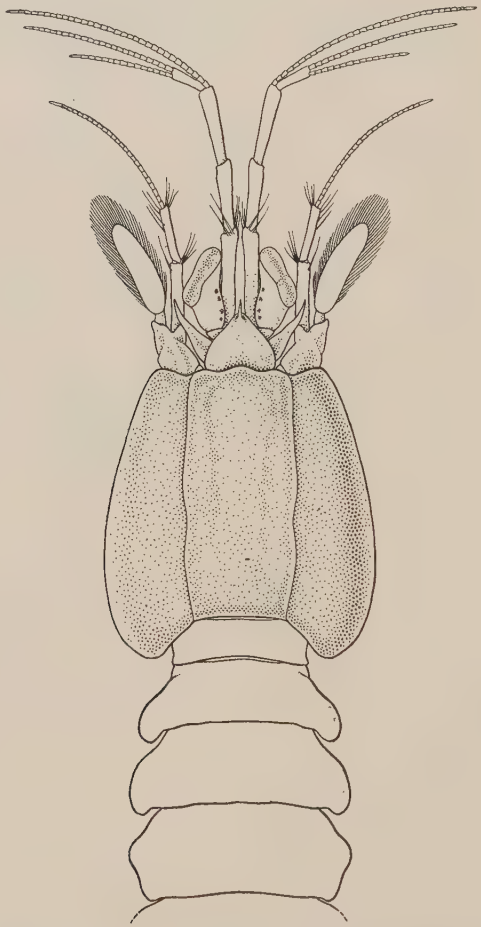
The species appears to be an inhabitant of shallow waters only. All the specimens that had hitherto been known were probably collected near the shore, though the exact provenance of some of them has not been recorded. The present examples were obtained at a depth of 73 metres, which is probably the greatest depth at which the species is so far known to live. The species seems to prefer a bottom of sand, and has been collected in some cases with *Balanoglosus* ; in the present instance the bottom consisted of coarse sand and shells.

L. multifasciata does not grow to a large size ; the largest specimen so far collected is probably the 64 mm. long male in the present collection. Kemp's largest example from the Philippines was only 56 mm. long.

Lysiosquilla sewelli, sp. nov.

Occurrence.—Station 176, Gulf of Aden, 695 metres. 1 ♀, 42 mm. Type.
Station 194, Gulf of Aden, 220 metres. 1 ♂, 32 mm.

Descriptive Notes.—The dorsal surface of the animal is smooth and polished. The carapace (Text-fig. 10) is without any carinæ, and is narrowed anteriorly. The antero-lateral angles are rounded, while the postero-lateral are produced backwards as broad, rounded lobes, extending considerably behind the posterior margin of the carapace. The



Text-fig. 10.—*Lysiosquilla sewelli* sp. nov. Carapace and exposed thoracic somites, dorsal view. × 4½.

length of the carapace in the median line is almost equal to its greatest breadth, which is a little in front of the posterior end. The gastric grooves are sharply marked from end to end, but the cervical groove is obsolete and its position is only faintly indicated by the vestige of a shallow depression on the outside of the gastric groove.

The rostrum is triangular in shape, with rounded sides, and the apex terminating in a sharp spine. Its length, including the spine, is almost equal to its breadth, a little in advance of the base. There is no carina on the rostrum and its surface is smooth.

The eyes are large, the breadth of the bilobed cornea being slightly more than the median length of the stalk and cornea combined. The corneal axis is obliquely placed to

the peduncular axis. The ophthalmic somite is completely hidden by the rostrum, and the shape of the dorsal processes cannot be made out in dorsal view.

The antennular peduncle is long, being hardly shorter than the median length of the carapace, excluding the rostrum. The dorsal processes of the antennular somite are large, horn-like structures, sharply pointed at the tip, and anteriorly reaching up to the cornea. The antennal scale is short and is less than half the median length of the carapace, The mandibular palp is well developed and composed of three segments.

The raptorial claw (Text-fig. 11) does not present any unusual features. The merus is longitudinally grooved ventrally and the outer inferior margin is broadly rounded distally. The carpus has a sharp dorsal carina, which terminates in an acute spine before

TEXT-FIG. 11.—*Lysiosquilla sewelli* sp. nov. Terminal portion of raptorial claw. × 10.

reaching the distal margin. The propodus is a little more than three times as long as broad ; the external margin in contact with the dactylus bears a series of rather long and closely-set pectinations, while at the proximal end of the internal margin there are 3 movable spines. The middle one of these spines is the smallest, and the most distal one is placed at a little distance from the other two. The dactylus is rather slender, and on its outer margin, at the basal end, there is a small lobe, followed by a rather deep concavity. There are 7 teeth, including the one at the apex, and these gradually increase in size from the proximal to the distal end.

The appendages of the third thoracic segment are distinctly longer than those of the fourth and fifth, which are subequal. The hands of the third and fourth legs are oblong in shape, that of the third being about twice as long as broad. The hand of the fourth leg is distinctly shorter and only slightly broader than that of the preceding appendage and is about one and a half times as long as broad. The hand of the fifth leg is also longer

than broad and is quadrate in shape, the distal border being somewhat longer than the proximal; it is as broad as the hand of the fourth appendage, but is slightly shorter. There is a thick tuft of hairs along the distal border. The ischium of the fifth leg is carinate along the inner border of the lower surface and ends in a minute spine at the distal end. An epipodite is present at the base of each of the first five thoracic appendages; in the type-specimen the epipodite of the raptorial claw of one side and of the fifth leg of the other side is missing, but the full complement of 5 epipodites is present on both sides in the other specimen.

There are no carinæ on the exposed thoracic somites. The lateral margin of the fifth thoracic somite is obscurely notched into two lobes, the anterior of which is bluntly rounded, and the small posterior one is somewhat sharply pointed. The margins of the sixth and seventh somites (Text-fig. 10) are produced posteriorly into a rounded lobe each. The eighth thoracic somite is the largest and its lateral margins are bluntly pointed in the middle.

The shorter ramus of the last 3 thoracic limbs is linear.

The abdomen is depressed and is, for the most part, smooth and shining. There are a number of fairly distinct longitudinal carinæ on most of the abdominal somites (Text-fig. 12, *a*, *b*). The marginal carina is present on the first 5 somites, though on the first, and to a certain extent on the second also, it is rather low and indistinct. The lateral carina is present on segments 4, 5 and 6, the intermediate on 5 and 6, while the submedian can be seen only on the sixth. Some of the carinæ on the sixth segment show a tendency of being broken up into tubercles or short carinæ. The carinæ on some of the segments end in distinct spines, the spine-formula being as given below:

Carinæ.	Abdominal somites.
Marginal	3*, 4
Lateral	4, 5†, 6
Intermediate	5, 6
Submedian	6

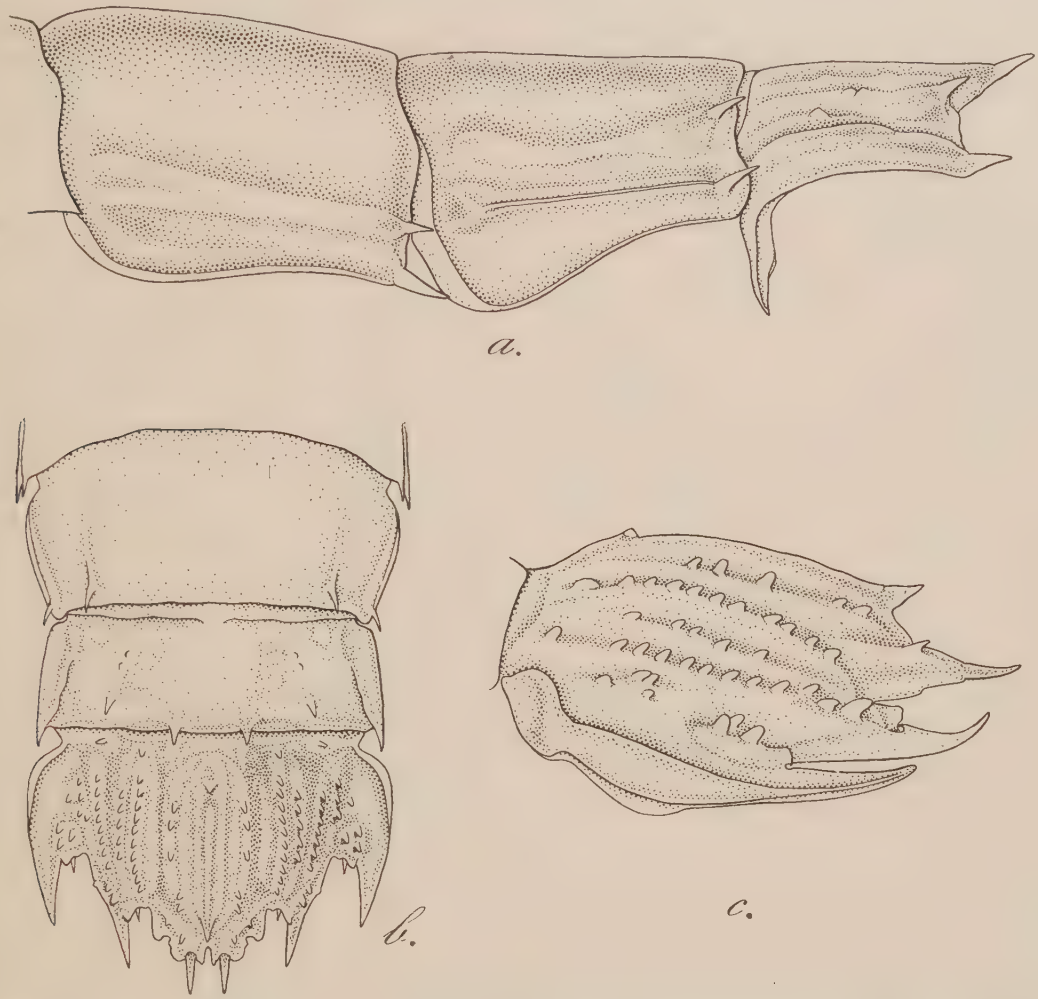
The sixth abdominal segment is short, being about three-fourths as long as the fifth. On its dorsal surface it bears 3 pairs of carinæ. The lateral carinæ, which are bifurcated near the base, appear to be fused with the marginal; the intermediates are somewhat broken up into tubercles; while the submedians are very short, and are clearly visible for a little distance only near the posterior margin. There are also a few scattered tubercles on this segment. Near the posterior margin there are 6 spines terminating the 3 pairs of carinæ; of these the intermediates arise a little in advance of the margin. The antero-lateral angle of this segment bears a long, sharp hook-like spine on the ventral surface. This spine is directed downwards and is prominently seen in a lateral view (Text-fig. 12, *a*).

The telson (Text-fig. 12, *b*, *c*) is a little less than twice as broad as long and is markedly convex above. The dorsal surface is ornamented with a number of longitudinal carinæ, most of which are broken up into tubercles. The median carina is greatly elevated and is entire; it terminates at its distal end in a sharp overhanging spine, and has another

* The marginal carinæ on the third segment end in acute angles rather than sharp spines.

† The marginal and lateral carinæ of the fifth somite, as seen in a dorsal view (Text-fig. 12, *b*), lie close to one another, but the lateral only ends in a spine. This is clearly seen in a lateral view (Text-fig. 12, *a*) in which the two carinæ appear well separated.

blunt, spine-like elevation near its proximal end. The only other carina that is entire is a little on the inside of the large lateral spine of the telson. Proximally it is at a little distance from the margin of the telson, but running obliquely outwards it comes to lie very close to the spine in its distal portion. On each side of the median carina, and running parallel to it, there is a longitudinal row of tubercles. There are three more broken carinæ or rows of tubercles on each side, almost opposite the intermediate teeth or spines of the telson. The innermost of these reaches the posterior margin a little on the inside of the



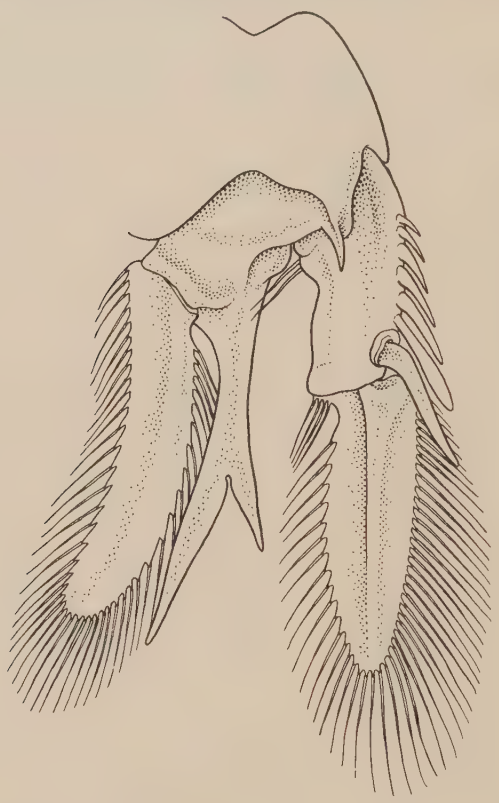
Text-fig. 12.—*Lysiosquilla sewelli* sp. nov. (*a*) Last three abdominal somites, lateral view. × 12. (*b*) Last two abdominal somites and telson, dorsal view. × 6. (*c*) Telson, lateral view. × 12.

marginal tooth; the next is short and does not reach the posterior margin; while the outermost of these reaches the posterior margin at the base of the intermediate tooth. Opposite the cleft between the intermediate and the lateral marginal teeth there are some tubercles, more or less arranged in lines. The three pairs of marginal teeth are long and are strongly developed. The submedians are mobile and the intermediates and laterals are upturned at their tips. The margin of the telson is somewhat deeply cleft between the submedian spines, and is lobed on either side between the submedian and the intermediate spines. There is a lobe at the base of lateral spine also. There are no submedian denticles, but there is one intermediate and one lateral denticle on each side, arising in

the usual manner on the ventral surface, and quite close to the lobes at the base of the spines.

The ventral surface of the telson is smooth and, except for the 2 pairs of minute denticles, which, as mentioned above, arise from the ventral surface close to the margin, there is no armature of spines or keels. The anus is slightly raised.

The peduncular segment of the uropod (Text-fig. 13) has a large overhanging carina along the outer aspect of the dorsal surface and a prominent spine at the distal end of the inner margin. The bifurcate process of the basal segment of the uropod is rather narrow and is quite smooth on its inner margin, and of the 2 spines the inner is more than twice as long as the outer. The proximal segment of the exopod has a large fixed spine



TEXT-FIG. 13.—*Lysiosquilla sewelli* sp. nov. Right uropod. × 12.

on the lower surface at the distal end, and 7 movable spines on its outer border. These spines increase in size from the proximal to the distal, and the last of these does not reach to the middle of the distal segment of the exopod. The distal segment is ribbed in the median line.

The foregoing description is chiefly based on the large female specimen from Station 176 ; this specimen is considered the type. The smaller male also resembles it very closely. The only appreciable difference between the two, apart from coloration, which is described below, is that the carinæ of the telson in the smaller specimen are not quite as well developed as in the type. The general plan of armature is identical in the two, but the carinæ are feebler, and the short row of tubercles between the two long intermediate rows is somewhat indistinct. These differences may possibly be due to the small size of the male.

Some measurements, in millimetres, of the two specimens are given below :

	Female from Station 176.	Male from Station 194.
Total length of body	42·0	32·5
Median length of carapace, excluding rostrum	7·3	5·8
Anterior breadth of carapace	5·5	4·5
Greatest breadth of carapace	8·3	6·3
Median length of fifth abdominal somite	4·2	3·1
,, ,, of telson, excluding submedian spines	5·0	4·0
Greatest breadth of telson	8·3	6·8

The type-specimen is whitish in colour, and has practically no pigmentation. On the inside of the eye-stalk there are five or six small, dark violet spots, and on the outside of the merus of the raptorial claw near its distal end there are four or five similar, but fainter spots. The spinules and tubercles on the telson are shining. The smaller male example has a distinctive colour-pattern. The ground colour is white, as in the female, but there is a profuse mottling of a brownish-orange colour. The antennular peduncle has a few spots of this tint, while the second segment of the antennal peduncle has a large patch. The dorsal surface of the eye-stalk has a large number of small spots of orange, and there is a diffusion of the same pigment on the rostrum and the carapace. On the latter there are also two more or less distinct streaks running longitudinally on the inside of the gastric grooves, and an aggregation of spots on the mid-dorsal region and another close to the posterior margin. In addition to diffused mottling, the merus of the raptorial claw has a large patch of brownish-orange on its outer surface, near the distal end, and a similar, but smaller patch is present on the carpus also. All the thoracic and abdominal somites are profusely mottled, besides each having a darker band close to the posterior margin. The telson has less of this mottling than the rest of the body. The basal segment of the uropod has also some streaks of pigment.

Distribution.—*L. sewelli* is so far known from the Gulf of Aden only, having been collected by the John Murray Expedition from two stations very close to one another in this area. The type-specimen was collected at a depth of 695 metres, while the other example was obtained in 220 metres of water. The sea-bottom at the place where the type was collected consisted of green mud and sand.

The determination of the exact systematic position of the species described above has been a matter of considerable difficulty and doubt. The species appears to combine the characters of a number of different genera, namely, *Lysiosquilla* Dana, *Pseudosquilla* Dana, *Squilla* Fabricius and *Coronidopsis* Hansen. In the loosely articulated and depressed abdomen the species presents the general appearance of a *Lysiosquilla*; the rostrum, carapace and the raptorial claws are also typical of this genus. The presence, on some of the posterior abdominal somites, of longitudinal carinæ, some ending in distinct spines, is a character very rarely met with in the genus *Lysiosquilla*; it is a characteristic feature of *Squilla*. Similarly the telson with the median carina strongly developed and an elaborate armature of broken longitudinal carinæ and spinule-like tubercles on the dorsal surface is more like that of *Pseudosquilla*, than of the species either of *Squilla* or *Lysiosquilla*. In *Pseudosquilla* the raptorial dactylus, however, is not known to have more than 3 teeth on its inner edge; in the present species there are 7, as is the case in some species of the genera *Squilla* and *Lysiosquilla*. With *Coronidopsis*, of which only one species is so far known, *L. sewelli* shows a fairly close general resemblance, but

in Hansen's genus, among other characters, the rostrum is of a very peculiar shape, no well-marked carinæ are present on the posterior abdominal somites (though some spines, more or less like those in my species, have been described by Hansen), and the under-surface of the telson is elaborately armed with spines and keels. I have mentioned here only a few important characters for comparison, but there are several other features also in which the present species shows its peculiarity.

In the genus *Lysiosquilla* I am not aware of any Indo-Pacific or Mediterranean species that shows any close resemblance with the present species. The only possible exception to this statement is the species described by Kemp (1913, pp. 126–128, pl. ix, figs. 99–102) under the name *L. insignis*. In this species there are some traces of longitudinal carinæ on the last two abdominal somites and some distinct carinæ are present on the telson also. There is, however, no median carina on the telson and there are also several other equally important differences between the two. The only near relations of *L. sewelli* that I can find are the two forms provisionally described by Bigelow (1901) from Porto Rico in the Atlantic under the names *L. plumata* and *L. maiaguesensis*. In these species, especially the latter, among other characters, the marginal and some other carinæ are present on the abdominal somites, the last of which has 6 spines on its posterior border and, in addition to the narrow lateral marginals, there are 3 distinct carinæ, including the median one, on the dorsal surface of the telson. The general resemblance between these two species, on the one hand, and the Arabian Sea form, on the other, is quite close. In Bigelow's species, however, there are fewer and less well-developed carinæ and fewer spines on the abdominal somites, and on the dorsal surface of the telson there are 3 distinct carinæ, instead of the elaborate armature that is present in *L. sewelli*. There are also several other specific differences between the two. It is noteworthy that Bigelow also remarked on the *Pseudosquilla*-like telson in at least one of his species.

It seems to me probable that *L. sewelli* and the two Porto Rico species represent a very specialized group within the genus *Lysiosquilla*, even more so than the group comprised by *L. insignis* Kemp and *L. latifrons* (de Haan), mentioned by Kemp (1913, p. 110). The first three species show some affinity to *L. insignis* on account of the fact that in all of them at least traces of longitudinal carinæ, some ending in spines, are present on the dorsal surface and the submedian teeth of the telson are mobile in all. In its sixth abdominal segment and telson *L. spinosa* (Wood-Mason) (see Kemp, 1913, pp. 118–120) also shows some slight resemblance to this group and may perhaps be a connecting link between it and the more typical species of the genus, but the peculiar shape of the ventral process of the uropod in Wood-Mason's species is a feature that is not met with in any other species of *Lysiosquilla*.

The only species of *Lysiosquilla* recorded by Kemp as occurring in depths of more than 100 fathoms are *L. insignis* and *L. maiaguesensis*—both these species, as discussed above, show some resemblance with *L. sewelli*.

Genus **GONODACTYLUS** Latreille.

Gonodactylus demani Henderson var. **spinosus** Bigelow.

Gonodactylus demani var. *spinosus* Kemp, 1913, pp. 165 and 198, 199 pl. ix, fig 122.
Gonodactylus demani var. *spinosus ?* Kemp and Chopra, 1921, pp. 309–311.
Gonodactylus spinosus Bigelow, 1926, pp. 579–582.
Gonodactylus De Mani var. *spinosus* Dollfus, 1938, pp. 215–217.

Occurrence.—Station B [? M.B. I(*b*)], Red Sea, 29 metres. 1 ♂, 18 mm.

Station M.B. I(*d*), Red Sea, 26 metres. 1 ♂, 22 mm.

Station 37, Gulf of Aden, 18–22 metres. 1 ♀, 28 mm.

General Discussion.—Hansen (1926, pp. 26–29) is of the opinion that *G. demani* is only a variety of the common Indo-Pacific *G. chiragra* (Fabr.). The latter species, as is well known, is extremely variable, especially in some characters of the telson, and it is often a matter of considerable difficulty to name young specimens of the *chiragra* group with any confidence. The variability, especially in young specimens, is so great that Lanchester, Borradaile and several other carcinologists have set up a large number of varieties of *G. chiragra*; this question has been very ably discussed by Kemp (1913). The three keels on the mid-dorsal portion of the telson may be sharp or rounded and may be moderately or markedly convex in a lateral view. The surface of the telson is generally smooth in typical examples of *G. chiragra*, but, as Hansen has shown, a few sharp spinules may be rarely present near the posterior end of the keels. In *G. demani* the surface is generally covered with spinules profusely, but sometimes the spinulation is only moderate to scanty, and in Borradaile's (1898) *G. espinosus*, which Kemp regards as a variety of *G. demani*, the surface is said to be quite smooth. The same variability is seen in the length and distinctness of the intermediate and lateral marginal teeth of the telson and to a certain extent in the relative length and breadth of the telson. Similarly, in typical examples of *G. chiragra* the keels on the submedian and intermediate teeth of the telson are usually sharp and distinct, but Hansen has described certain specimens in which these keels are rounded, more or less as in *G. demani*. Kemp has mentioned the dorsal processes of the ophthalmic somite as another character useful for separating *G. demani* from *G. chiragra*; this character, though certainly useful in a general way, cannot be relied upon, as Hansen has also stated, in the case of young individuals to the extent that Kemp has suggested.

I have, however, preferred to follow Kemp and some later workers in regarding *G. demani* as a distinct species, rather than a variety of *G. chiragra*. In Henderson's species the dorsal surface of the telson, with the enormously swollen keels separated from one another and from the rounded keels on the submedian and intermediate marginal teeth by narrow V-shaped grooves, presents a facies that can be scarcely confused with that of the telson of *G. chiragra*. The figures given by Kemp (1913, pl. ix, figs. 109–112) and Dollfus (1938, p. 214, fig. 16, p. 216, fig. 17) clearly show the appearance of the telson in *G. demani* and its varieties.* I have examined a number of very young examples of *G. chiragra* in the collection of the Indian Museum and the telson generally presents a sufficiently different appearance from that of same-sized specimens of *G. demani* to render the recognition of the two species possible. The median keel is extremely convex in lateral view, considerably more so than in any of the very large number of specimens of *G. chiragra* that I have examined. I have seen no specimen of *G. chiragra* with spinules on the dorsal surface of the telson. Another very important and constant character that marks off *G. demani, forma typica*, from *G. chiragra* is the absence, in the former, of setæ on the inner margin of the endopodite of the uropod. There are, however, varieties of *G. demani* in which this character does not hold good. Lastly in large examples at least the dorsal

* The figures given by Gravier (1935) do not appear to be those of *G. demani* and certainly not of the *forma typica*. There are wide spaces between the keels on the telson and the inner margin of the endopod has a fringe of setæ.

processes of the ophthalmic somite are much smaller in *G. demani* than in specimens of the same size in the other species. *G. demani* is also a much smaller form than *G. chiragra*; I have seen several specimens of the former species well under 30 mm. in length with their eggs.

Hansen has also discussed the question of the presence or absence of spinules on the telson of his *G. œrstedi*—a species that replaces *G. chiragra* in the Atlantic and is found in certain parts of the Pacific also. In Hansen's species such spinules are, as a rule, absent, but in several examples examined by him a few spinules have been noticed and Nobili has even given a separate specific name for such spinule-bearing forms. Bigelow (1931), who has also discussed the question of the different species and varieties in the *chiragra* group at some length, considers Nobili's *festœ* as a variety of *G. œrstedi*; he has also included another spinule-bearing form as a variety of Hansen's species. On the analogy of *G. œrstedi*, Hansen has argued that the form of *G. chiragra* bearing spinules on the telson cannot be recognized as a distinct species. It is thus seen that in *G. œrstedi* and, to a certain extent, in *G. chiragra* also there is a gradual transition from smooth forms to forms bearing spinules on the telson; similarly (as remarked by Kemp and Bigelow) in *G. demani* also a transition from forms that are profusely spinulate to forms that are almost or quite smooth can be traced. This character—the presence of spinules on the telson—seems to have been evolved in these three species independently and along parallel lines.

Hansen has discussed another interesting question, namely, the presence, in his specimens of *G. demani*, of a longitudinal "impression" on the "intermediate" dorsal carina of the telson, nearly dividing each carina into two parallel keels. This indicates a transition to a condition in which five keels are normally present on this part of the telson, as, for example, in *G. glabrous* Brooks (*vide* Kemp, 1913, pp. 167–169, and Bigelow, 1931, pp. 127–135). Lanchester (1903) had already suggested such a transition and had in fact regarded *G. glabrous* only a variety of *G. chiragra*, but, as shown by Kemp and Bigelow, *G. glabrous* certainly deserves specific rank. In one or two specimens in the John Murray Expedition collection that have been provisionally referred to Borradaile's variety *espinosus* of *G. demani* (*vide* p. 178, *infra*) a shallow longitudinal groove, somewhat similar to the one described by Hansen, has been seen.

The *chiragra* group of *Gonodactylus* is thus seen to be a very homogeneous one, and the limits between the different species and varieties are sometimes not well defined. *G. chiragra*, the parent form, like several other members of the group, is exceedingly variable, and a large number of varieties have been described, but Kemp has, in my opinion rightly, merged most of them with the *forma typica*, recognizing only Wood-Mason's *platysoma* (see also Bigelow, 1931) as a valid variety. In the Atlantic and in certain parts of the Pacific *G. chiragra* is replaced by Hansen's *G. œrstedi*, which is characterized by the presence of an additional keel on the inside of the keel on the intermediate marginal tooth of the telson. *G. œrstedi* also shows considerable variation in the matter of spinules on the telson, and two varieties, *festœ* Nobili and *spinulosus* Schmitt (*vide* Bigelow, 1931, pp. 123, 124), based at least partly on this character, have been recognized. *G. demani*, the other very near relation of *G. chiragra*, is characterized, among other features, by the presence of enormously swollen and convex ridges on the median part of the telson; this species again shows considerable variation chiefly in regard to the spinules on the telson, ranging from forms that are profusely spinulate to forms that are quite smooth. Another

important variation noticed in this species is the presence or absence of setæ on the inner margin of the endopod of the uropod, but, unlike the spinules, these setæ are either absent (*forma typica*) or present (vars. *spinosus* and *espinosus*), there being no intermediate forms in which the setæ are reduced either in number or in size. Two varieties of *G. demani* Henderson, *spinosus* Bigelow and *espinosus* Borradaile have been recognized, but the latter is very imperfectly known. Partly removed from *chiragra* and its two closest allies, referred to above, are the two 5-keeled species, *G. glabrous* Brooks and *G. graphurus* Miers. As mentioned above, specimens of *G. chiragra* and *G. demani* have been recorded that show a transition from the 3-keeled to the 5-keeled stage. *G. graphurus* can be easily distinguished, among other characters, by the presence of fine transverse and longitudinal grooves on the first five abdominal somites. I have not taken into account in this synopsis de Man's *G. acutirostris*, as comparatively little is known of this species ; Kemp has suggested that the species may have been based on an abnormal specimen of *G. chiragra*. I have given here in brief my views on the relationships of the different members comprising the *chiragra* group of *Gonodactylus* ; these are practically the same as so ably and fully discussed by Kemp in 1913. Bigelow (1931) has also gone into this question in some detail and is in substantial agreement with Kemp on most of the important points.

Descriptive Notes.—Following the suggestion of Tattersall (1921), Kemp and I suggested in 1921 that Bigelow's (1893) *Gonodactylus spinosus* can probably be distinguished from *G. demani* by the presence in the former and absence in the latter of a fringe of setæ on the inner border of the endopod of the uropod. As it was not known whether Bigelow's type-specimen has these setæ or not, we suggested that, pending a re-examination of the type, Bigelow's form may be designated var. *spinosus?* of Henderson's *G. demani*. This doubt has since been removed by Bigelow's redescribing the type and showing that a fringe of setæ is present on the inner margin of the endopod. The type-specimen is further characterized by having small dorsal processes of the ophthalmic somite and by the telson being thickly covered with spinules and being as long as broad. Further, the intermediate and lateral marginal teeth of the telson are greatly reduced. I have examined several specimens of this variety from the Indian Museum collection and have found some variation in the amount of spinulation and in the relative size and distinctness of the marginal teeth of the telson. In Bigelow's figure of the type the lateral teeth are shown as practically absent and the intermediates as greatly reduced. In some of the specimens I have examined the condition is very much like this, though the lateral teeth are always a little more distinct than shown by Bigelow. The intermediate teeth also are sometimes better developed, and in some examples are large and separated from the submedians by large, deep notches. The spinulation on the telson, in all the Museum specimens that I have seen, is profuse to moderate and only very rarely somewhat scanty.

The three specimens in the John Murray Expedition collection are more or less typical. The telson is profusely spinulate and is almost as long as broad. The intermediate marginal teeth are well developed, and are separated from the submedians by deep incisions. The lateral marginals are considerably reduced, but are fairly distinct. The inner margins of the submedian teeth are finely serrate, and the tips of the teeth are provided with small articulating spines. The inner margin of the endopod is furnished with long hairs, which, as mentioned by Bigelow, are pinnate, like those on the outer border. There are 10–11

movable spines on the outer margin of the proximal segment of the exopod.* The carinæ of the sixth abdominal somite are also swollen and end in spines. The dorsal processes of the ophthalmic somite are small.

In the largest specimen, a female from Station 37, there is an indistinct transverse patch of colour on the posterior third of the carapace, and a broad transverse band on the sixth thoracic and first abdominal somites. There are indistinct diffused bands on some of the other abdominal somites also. In the male 18 mm. long there is a large number of small dark, almost black, chromatophores on various parts of the body. Some of these are aggregated on the posterior part of the carapace and some on the sixth thoracic and first abdominal somites. There are a few of these spots on some of the other abdominal somites also. On the telson there are two spots just under the tips of the submedian carinæ of the sixth abdominal somite, and another two indistinct ones under the tips of the intermediate carinæ also. In the third specimen the patch on the carapace is not seen, but those on the sixth thoracic and the first abdominal somites are quite distinct, as are also the four small spots near the anterior margin of the telson.

G. demani var. *spinosus* does not grow to a large size, the largest specimen so far recorded is under 40 mm. long. The *forma typica* also does not attain a large size, the largest example recorded by Kemp and Chopra from the Gulf of Suez was a little over 40 mm., and some females under 30 mm. in length, collected by Kemp in the Gulf of Manaar, were found to be guarding their eggs.

Distribution.—The variety has an extensive range of distribution over the Indo-Pacific region. Bigelow has described its range as extending "from Mauritius on the south to the Gulf of Suez, the Red Sea, and Persian Gulf on the north, and from Zanzibar and Ibo Archipelago, Portugese East Africa, in the west to the Sea of Java in the east". *G. demani* (*forma typica*) has also a somewhat similar range, though it has also been recorded further east than the variety. As remarked by Kemp and Chopra, the *forma typica* and the variety are both met with in the Red Sea, the Persian Gulf and the Gulf of Manaar.

The variety *spinosus*, like the typical *G. demani*, is not known to live in deep waters, most of the specimens so far recorded having been collected in the littoral at depths of a few fathoms only. The present examples also are not from any depth greater than 16 fathoms. The bottom at the place of capture consisted of sand, or of sand mixed with shells and corals.

Gonodactylus demani Henderson var. **? espinosus** Borradaile.

Gonodactylus espinosus Borradaile, 1898, pp. 35, 36, pl. v, figs. 5, 5*a*, 5*b*.
Gonodactylus demani var. *espinosus* Kemp, 1913, pp. 166, 167.

Occurrence.—Station 45, South Arabian coast, 38 metres. 5 ♂♂, 9 ♀♀, *ca.* 13–22 mm.
Station B [? M.B. I(*b*)], Red Sea, 29 metres. 1 ♀, *ca.* 11 mm.

Descriptive Notes.—In the matter of spinulation on the dorsal surface of the telson, *G. demani* is so variable that Kemp (1913, p. 153) suggested that should a wholly smooth example of this species be ever found it would only appear as the last link of a chain of continuous variation. Borradaile's *G. espinosus*, which Kemp regards as a variety of Henderson's species, appears to be such a form. The variety is based on a single male

* Dollfus (1938) has mentioned 12 or 13 movable spines in one of his specimens.

specimen, about 18 mm. long, obtained from Rotuma Island, on the north of Fiji, in the Southern Pacific. It resembles very closely *G. demani*, or rather its variety *spinosus* Bigelow, except in so far that there are no spinules on the telson. The telson is broader than long in Borradaile's variety, as also in the *forma typica*, but in Bigelow's variety *spinosus* the length and breadth of telson are almost equal. The inner border of the endopod of the uropod is fringed with setæ, thus differing in this respect from the typical form, but agreeing with var. *spinosus*.

There are, in the present collection, 15 small specimens of a *Gonodactylus* that I refer with considerable hesitation to Borradaile's *espinosus*. They vary in size from about 11 mm. to about 22 mm. from the tip of the rostrum to the tip of the submedian teeth of the telson, and both the sexes are represented in the collection. In all of them the telson is quite smooth ; the three ridges on the dorsal surface of the telson are greatly swollen and the middle one is very convex ; the telson is distinctly broader than long ; the intermediate marginal teeth are greatly reduced ; and the lateral marginals are obsolete, or even almost absent. The dorsal processes of the ophthalmic somite are small and the inner margin of the endopod of the uropod has setæ in all the examples. The specimens in a general way appear to belong to the *demani* section of the *chiragra* group, and, except for one or two differences, chiefly in the proportion of the telson, represent a non-spinulate phase of *G. demani* var. *spinosus*.

The characters enumerated above apply to all the specimens in a general way only, considerable variations in some of them being seen when they are examined in detail. In at least three examples, a male and two females, the condition is exactly as seen in Borradaile's figure ; the dorsal carinæ of the telson are enormously swollen and convex, and are separated from one another and from the rounded carinæ on the marginal teeth by narrow V-shaped spaces, the intermediate marginal teeth are considerably reduced and the laterals are altogether obsolete, the telson is distinctly broader than long and the carinæ on the sixth abdominal somite also are as seen in the figure of the type. There are, of course, no spinules on the telson. There seems little doubt that these three examples at least are referable to Borradaile's variety. There are other specimens, however, in which the dorsal carinæ are a little less swollen, the submedians a little less convex, the spaces between them and between the rather less rounded carinæ on the marginal teeth a little wider, and the intermediate marginal teeth a little more distinct. In two or three extreme cases the spaces between the carinæ are fairly wide, the submedian carinæ and the carinæ on the marginal teeth are rather sharp, and the intermediate marginal teeth are fairly well formed. In these specimens, all rather small, the telson is like that of *G. chiragra*. Another point worth mentioning is that though the lateral marginal teeth of the telson in all the specimens are obsolete or missing, more or less as in Borradaile's figure, in no example are the indentations of telson margin quite as reduced as shown in the figure. It is thus seen that there are some specimens in the present collection which resemble almost exactly Borradaile's *espinosus*, while there are others in which the telson comes quite close to that of *G. chiragra* ; between these two extremes the variation in the matter of the shape of the carinæ and their interspaces is almost continuous. It is, however, noteworthy that it is in small specimens only that the *chiragra* condition is well marked.

Another variable character seen in my specimens is the comparative development of the fluke-like prolongations at the posterior end of the median carina on the dorsal surface

of the telson. Borradaile's figure shows that this carina is uniformly swollen and rounded, and that there are no flukes at the posterior end. There are some specimens in my collection in which this condition prevails, but there are others in which the median carina is narrowed distally, and the posterior end has two fluke-like projections, sometimes small and insignificant, but in one or two cases large and well developed, as in *G. chiragra*.

In two specimens in the collection there is a faint and shallow longitudinal groove on each of the swollen submedian carinæ of the telson, imperfectly dividing it into two parallel keels. Hansen (1926, p. 28) described such longitudinal " impressions " in some of his specimens of *G. demani*, and suggested that this constituted " to some degree a transition towards *G. glabrous* Brooks, though it must be emphasized that the surface of the telson in *G. glabrous* with its five dorsal carinæ shows always an aspect of its own ".

In most of the specimens in the John Murray Expedition collection there are 9 movable spines on the outer margin of the proximal segment of the exopod of the uropod ; in one example there are 9 on one side and 10 on the other and in another there are 10 on each side.

The identification of the present specimens has been a matter of considerable difficulty. Two or three specimens with enormously rounded and convex keels, separated by narrow, V-shaped spaces, and possessing the other characters referred to above, appear to be clearly referable to Borradaile's *espinosus*. On the other hand, there are two or three examples which suggest the possibility of their being young individuals of *G. chiragra*. Between these two extremes there are intermediate forms. In all the specimens, however, the median keel of the telson is considerably swollen, more or less as in the *demani* section of the *chiragra* group, the smooth telson is broader than long, the marginal teeth of the telson, excepting the submedians, are considerably reduced, the spaces between the various carinæ, though variable in extent, are never really broad, and the dorsal processes of the ophthalmic somite are small. The combination of these characters has led me to refer the specimens to the variety *espinosus* of Borradaile. Like all other members of the *chiragra* group, this variety also is no doubt extremely variable in a number of characters.

All the specimens in my collection are small and probably immature, but it is noteworthy that the *chiragra* characters, referred to above, are most apparent in very small individuals only and tend to vanish or are at least toned down in larger examples. It seems likely that very young specimens present a somewhat generalized type of the group, becoming more and more differentiated with subsequent growth and assuming the full characters of the species or variety at or near maturity. Discussing the variations in the *chiragra* group, Kemp (1913, p. 151) was inclined to the view that distinctions between the varietal and typical forms are more pronounced in the young than in adults, or that small specimens greatly differing from one another and appearing to represent distinct varieties, etc., lose their peculiar features at subsequent moults and approximate to the typical form when they grow up. The small collection that I have studied does not support this view. Bigelow (1931, p. 111) has also discussed this point and is unable to agree with Kemp's hypothesis.

Several of the specimens have no colour at all, but in some there are distinct spots of a blackish colour on different parts of the body. In the posterior third of the carapace there are two to four small spots, and on the sixth thoracic and first and fourth abdominal somites there are two or three similar spots, which on the first abdominal are sometimes fused into a patch. On the sixth abdominal segment there is generally a small patch on

each side near the junction of the uropod and the basal part of the uropod is also pigmented. There is, in some cases, a general diffusion of minute chromatophores, which are especially aggregated on the margin of some of the thoracic and abdominal somites. Most of the colour markings are rather faint. Borradaile described the colour of the type-specimen as " a uniform dark olive-green ".

Distribution.—The variety was originally described from Rotuma Island, north-east of Fiji, in the Southern Pacific, " far distant from the region in which typical *G. demani* or var. *spinosus* have been found " (Kemp, 1913, p. 167). The present specimens are from the South Arabian coast and the Red Sea—localities in which both the *forma typica* and Bigelow's *spinosus* are also known to live. Borradaile's variety has thus been recorded from the two extreme ends of the Indo-Pacific region, but will probably be found in other localities also in this area. The variety lives in comparatively shallow waters only ; no details of depth have been recorded for the type, but the present examples are from depths under 40 metres. One specimen from Station 45 (South Arabian coast) was pulled off calcareous sponges or removed from the *débris* in the jar containing these. The sea-bottom at this station consisted of lithothamnion, while at the Red Sea station it was of sand, shell and coral.

Gonodactylus chiragra (Fabricius), *sensu lato*.

Gonodactylus chiragra, Kemp 1913 ; Bigelow, 1931.

Occurrence.—? Station 33, Gulf of Aden, 1295 metres. 1 ♀, *ca.* 12 mm.

Descriptive Notes.—In the tube containing telsons and other fragments of *Squilla investigatoris* Lloyd (see *supra*, p. 157) there is a small specimen of a *Gonodactylus* that belongs to the *chiragra* section of this genus. It is too small for satisfactory identification, but possibly belongs to *G. chiragra s.s.* The telson shows most of the characters of *G. chiragra*, but, as stated above, very young individuals in the *chiragra* group appear to have a generalized form, and probably assume the peculiar features of their species and varieties only when they grow up. The median keel on the telson is rounded and swollen, and has small fluke-like projections at the posterior end. The submedian keels are rather sharp and are separated from the median keel and from the somewhat sharp keels on the marginal teeth of the telson by wide gaps. The telson is smooth and is distinctly broader than long. The intermediate marginal teeth are well developed, and the laterals are obsolete, even their marginal notches being hardly discernible. The inner margin of the endopod of the uropod is fringed with setæ. There are 10 movable spines on the outer margin of the basal segment of the exopod on each side.

The specimen shows a few minor differences from typical examples of *G. chiragra* that may be mentioned. The antero-lateral angles of the rostrum are more broadly rounded than is usually the case. The carapace is almost as long as its greatest breadth, is very little narrowed in front, and its broadly rounded antero-lateral angles extend only very slightly beyond the rostral base. The bifurcate process of the uropod is also slightly different. The emargination between the two spines is deeper than is generally the case, and the outer spine, which is distinctly longer than the inner, extends a little beyond the distal margin of the last segment of the exopod.

Apart from its correct identification, the great importance of this specimen lies in the fact that it has presumably been dredged from the enormous depth of about 1300 metres.

All the records of *G. chiragra* and of other members of the *chiragra* group are from coral reefs and other similar situations in comparatively shallow waters only ; in fact I am not aware of any *Gonodactylus* known from depths exceeding 100 fathoms. If the present record, from a depth of about 700 fathoms, is correct, the bathymetric range of the genus is enormously increased. Apart from the great depth, the sea-bottom at Station 33 is stated to consist of green mud—a habitat hardly likely to be the home of a *Gonodactylus*. It is possible that the specimen was not really collected at this great depth, but got accidentally mixed with *Squilla* fragments from Station 33 at some later stage.

LIST OF LITERATURE.

[Only papers referred to in the present report are given in this list. For detailed bibliography see Kemp (1913) and Bigelow (1931). Komai (1927) and Dollfus (1938) have also given very useful lists of references. The bibliography recently (1938) given by Balss in his account of the Stomatopoda in Dr. H. G. Bronn's 'Klassen und Ordnungen des Tierreichs' is a very comprehensive one, and in addition to systematics, contains also a large number of references to literature dealing with the morphology, development, etc., of the group.]

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